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THE MAGAZINE OF THE WORLDWIDE ELECTRONICS INDUSTRY

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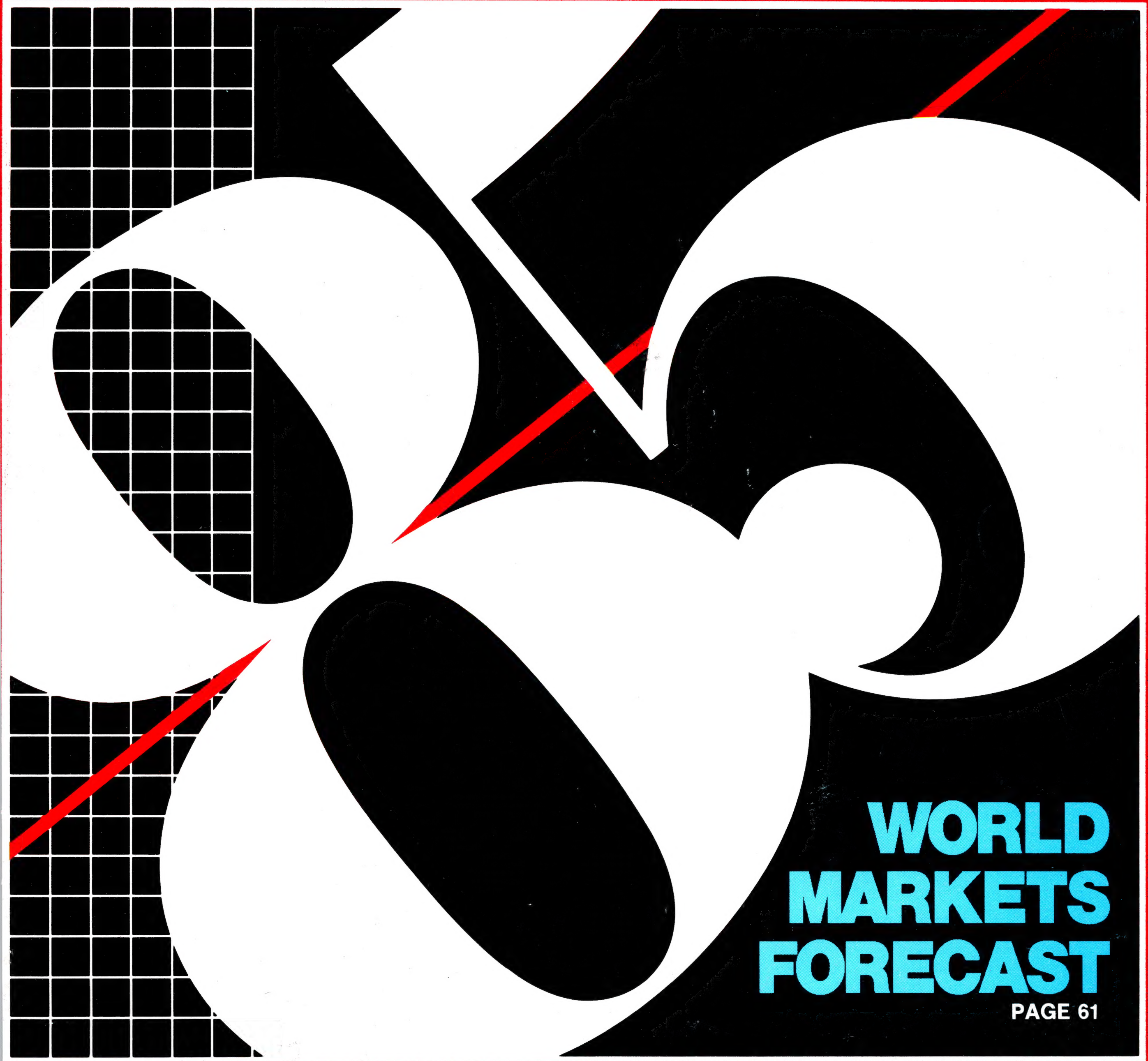

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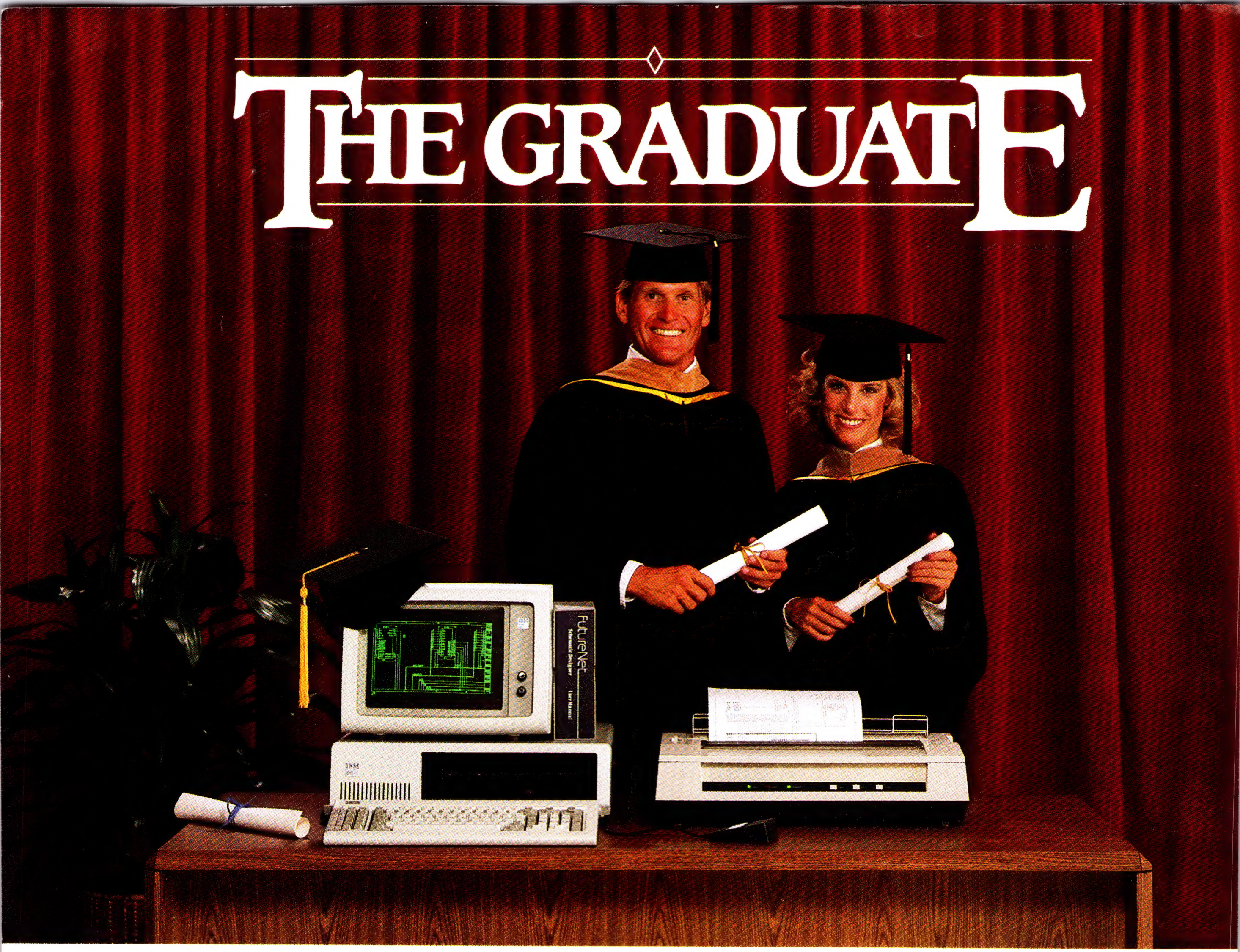

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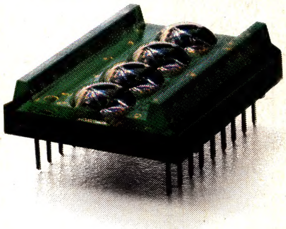

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Next ElectronicsWeek

Winter CES beams spotlight on consumer technologies to watch

The bills for Christmas 1984 may still be unpaid, but the consumer electronics people are about to assemble in Las Vegas to decide which technologies to put their money on for the Christmas 1985 selling season. One early-line favorite is the product that is based on modified industrial technology; one example is the robot for the home. That, among other entries, will be paraded at the Winter Consumer Electronics Show, one of the most important events in that segment of the electronics business. For a sneak preview of what the trend is leading to, see the special technology report in the next issue of *ElectronicsWeek.*

Get the answers to questions about new digitizing scopes

What does "random repetitive sampling" mean? Why would anyone want to use it? How does it compare to other sampling techniques and to analog, real-time oscillography? These questions are the key to understanding the contributions of the new digitizing oscilloscopes entering the marketplace. Where to find the answers? An article in the next *ElectronicsWeek* has them.

Looking ahead in ElectronicsWeek

ElectronicsWeek's annual Award for Achievement will be announced in the Jan. 14 issue. This year's winner will join a list of illustrious names in the electronics industries that includes luminaries from such fields as semiconductors, components, computers, and software. The first winner, in 1974, was Gordon E. Moore, chairman of Intel Corp. Among those following him have been the four developers of integrated injection logic (I^2L); Richard Dobkin, for linear-circuit development; Paul Richman, for advanced developments in MOS technology; Carver Mead and Lynn Conway, for work in structuring the design of VLSI curcuits; and Ken Thompson and Dennis L. Ritchie, for developing the computer operating system Unix as well as the high-level language C.

January 1, 1985 Volume 58, Number 1
103,604 copies of this issue printed

ElectronicsWeek (ISSN 0748-3252). Published weekly by McGraw-Hill Inc. Founder: James H. McGraw 1860-1948. Publication office: 1221 Avenue of the Americas, N. Y., N. Y. 10020; second class postage paid at New York, New York and additional mailing offices. Postage paid at Montreal, P. Q. Registration Number 9034.

Executive, editorial, circulation, and advertising addresses: ElectronicsWeek, McGraw-Hill Building, 1221 Avenue of the Americas, New York, N. Y. 10020. Telephone (212) 512-2000. Teletype 12-7960 TWX 710-581-4879. Cable address: MCGRAWHILLNEWYORK.

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MARKET FORECAST
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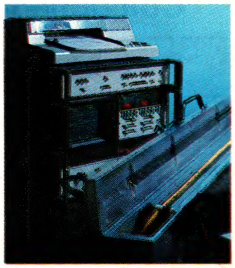

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VOLUME 58, NO. 1 JANUARY 1, 1985

ElectronicsWeek

Special Technology Reports

World Markets Good gains are in store for major markets in 1985 despite signs of a slowdown in the overall growth of the world's economies. Annual forecast shows worldwide production of electronics equipment will increase to $492.5 billion **61**

Semiconductors MOS technology is meeting the radiation challenge. The new generation of MOS chips has geometries and processing techniques that stand up to X and gamma rays **89**

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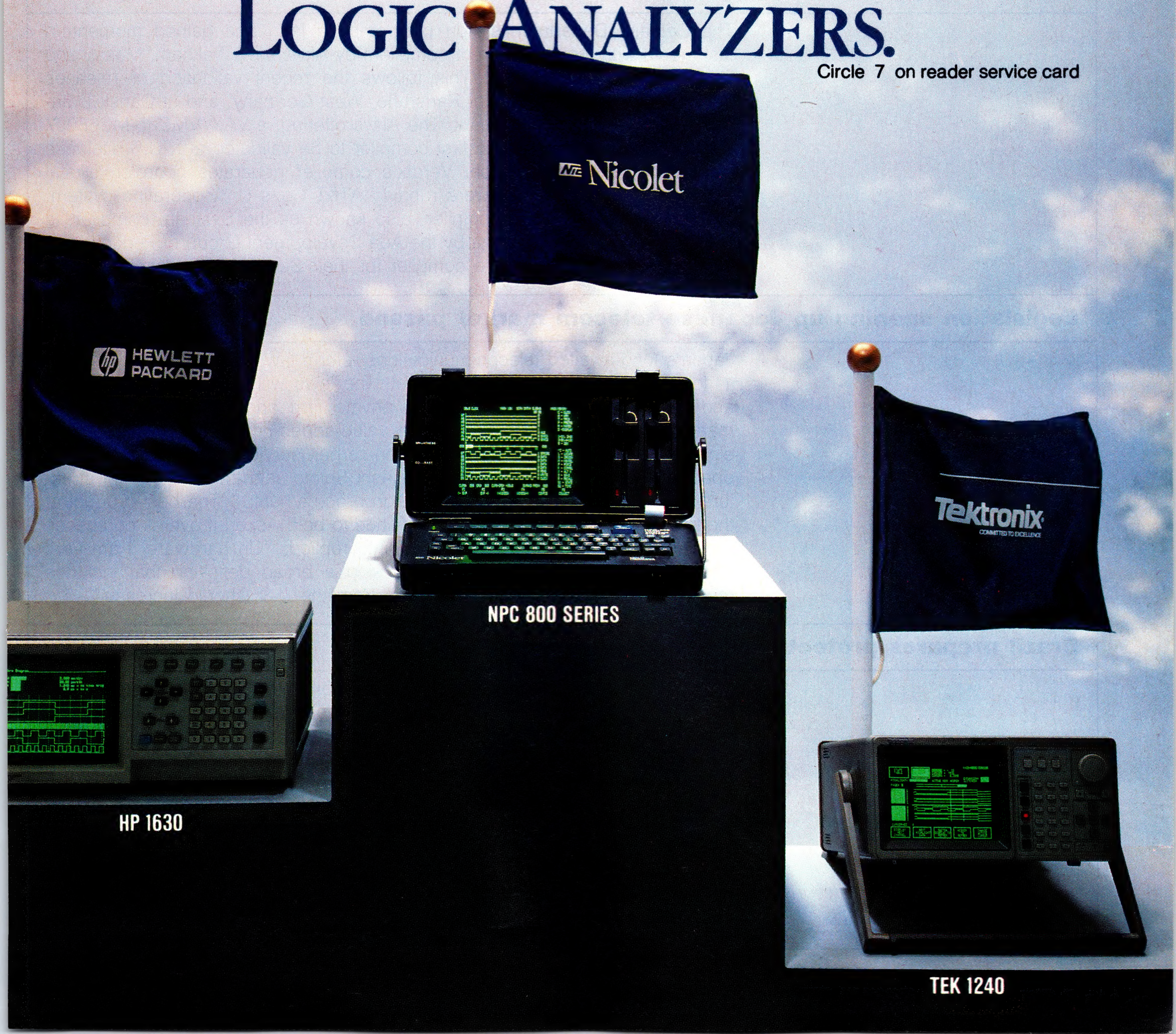

Dispute continues over review rights on high-technology exports

The Departments of Commerce and Defense are still wrangling over which of the two should have the right to review applications for licenses to export commercial high-technology products to non-Warsaw Pact nations. Assistant Secretary of Defense Richard N. Perle last week accused the Commerce Department of reneging on an oral agreement between Perle and Under Secretary of Commerce for International Trade Lionel H. Olmer to give that review role to the DOD. Perle says a written memo cementing the deal was never signed because Commerce Secretary Malcolm Baldrige refused to approve it. The memo is now on President Reagan's desk, where the matter is expected to be resolved "in a couple of weeks," according to Baldrige.

Ada aided by increase in compiler validations

The Defense Department's Ada programming language gained momentum last month with the validation of compilers by Alsys Inc., Waltham, Mass., and Verdix Corp., McLean, Va. This follows the recent validation of releases developed at the University of Karlsruhe, West Germany, and at Dansk Datamatik Center, Lyngby, Denmark. The Alsys offering, a VAX/VMS-to-MC6800/Unix cross-compiler, was the first compiler to be validated at a U.S. Defense Department center in France. Verdix's compiler generates code on Digital Equipment Corp. VAX hardware running AT&T Co.'s Unix operating system. The Karlsruhe VAX/VMS compiler, also known as the Systeam compiler, is the basis for work being done by the Ada Development Group of Perkin-Elmer Corp., Oceanport, N.J., for a compiler for their Series 3200 processors.

Legislation opening up Japanese telecom market passed

Japan's long-awaited telecommunications reform laws will take effect on April 1, following their passage by the Diet. The laws will turn Nippon Telegraph and Telephone Public Corp. into a private firm and divide the Japanese market between common-carrier and value-added-network enterprises. Foreign firms are excluded from common-carrier services, but the VANs are open to all comers. NTT president Hisashi Shinto said the new market structure will not change his policy on foreign procurement: " 'The best product at the best price' is my rule, and will continue to be." Asked if overall purchases from U.S. sources would increase, Shinto replied, "On hardware, I am very pessimistic. On software—and I am using a broad definition that includes research and development—purchases from the U.S. should increase."

Brazil prepares protectionist stance for robotics makers

Brazil's nationalistic Special Secretariat for Informatics (SEI) has taken the first steps toward protectionism in the field of industrial robotics by inviting local firms to submit plans for the manufacture of robots, using either in-house or purchased technology. The next step could be the creation of a reserved market share for 100% Brazilian-owned companies. Says an SEI spokesman: "When you've invited local businessmen to invest in the sector, they will require some protection to know the market isn't open to everybody." About 10 firms are already engaged in some aspect of robot development in Brazil [*ElectronicsWeek,* July 30, 1984, p. 32], while 14 imported robot systems are in operation. Brazilian-owned companies have until Feb. 28 to submit their plans to the SEI, which promises to give a go-ahead by the end of April.

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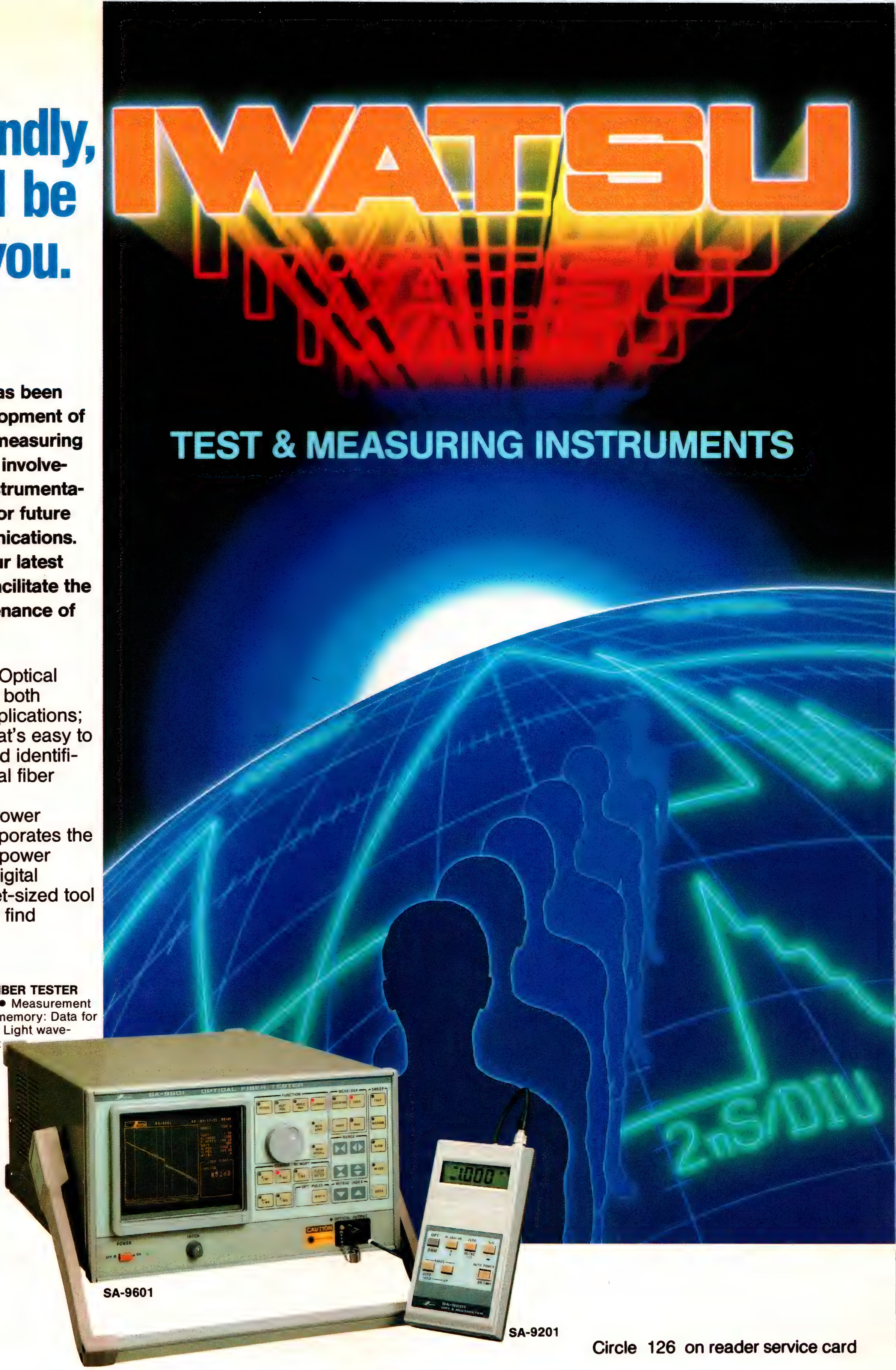

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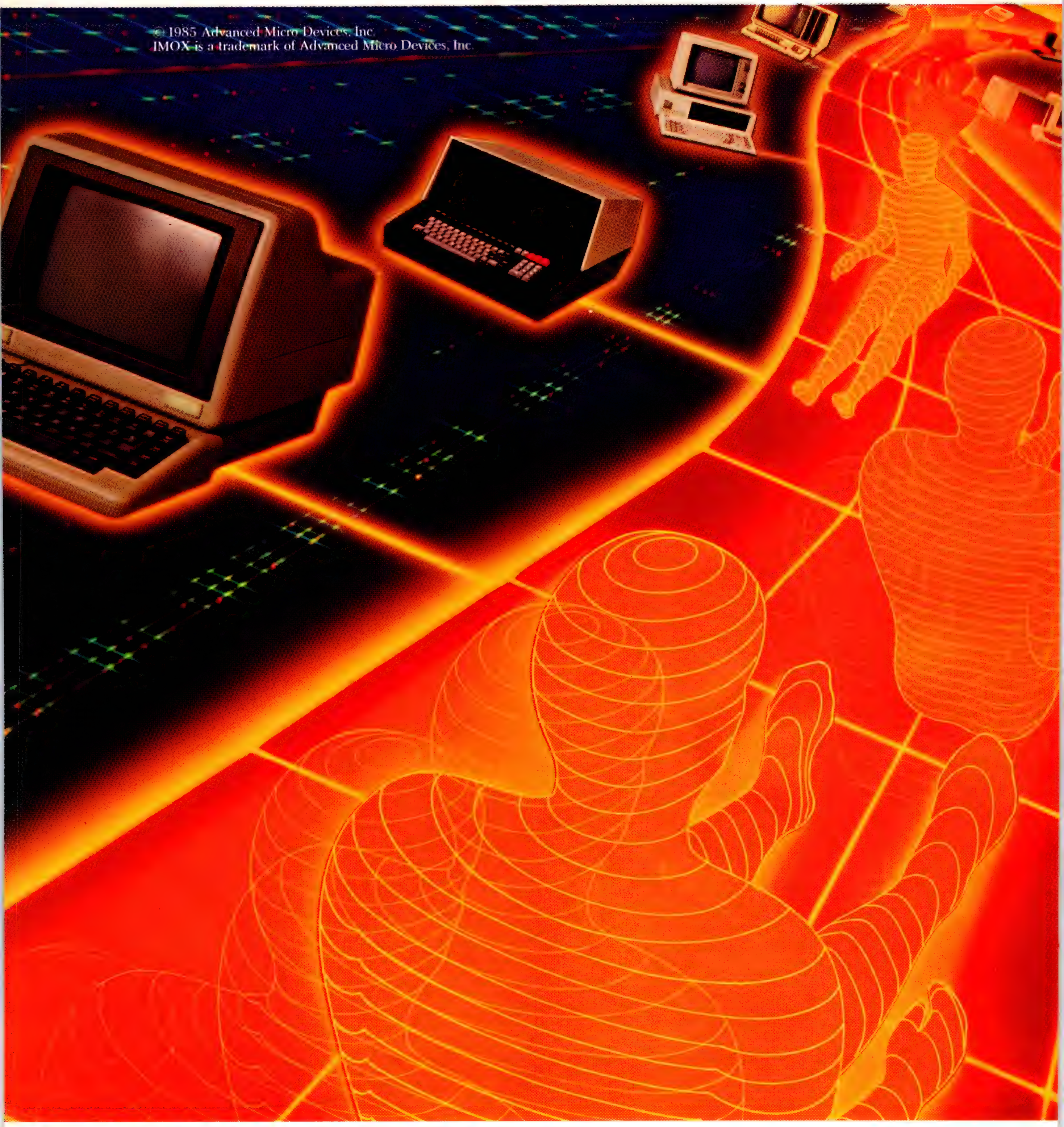

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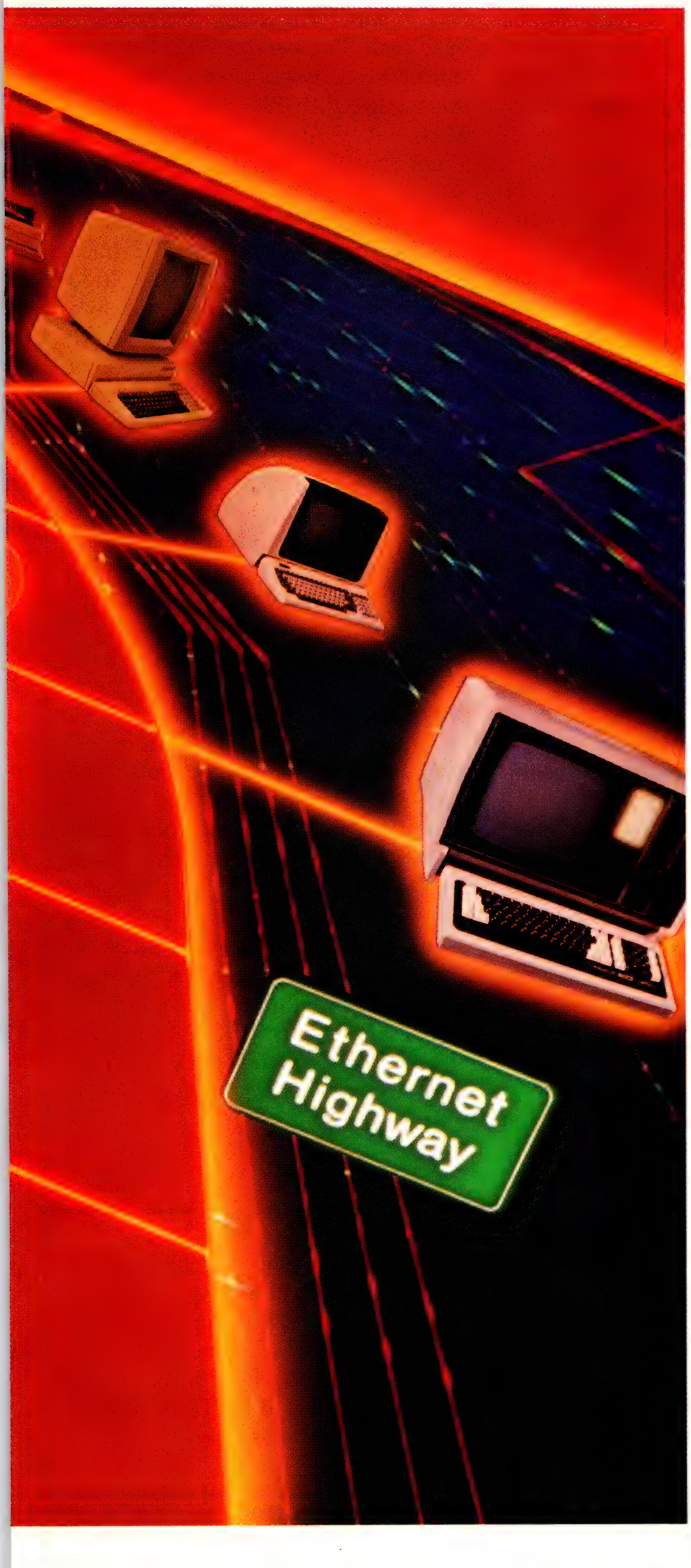

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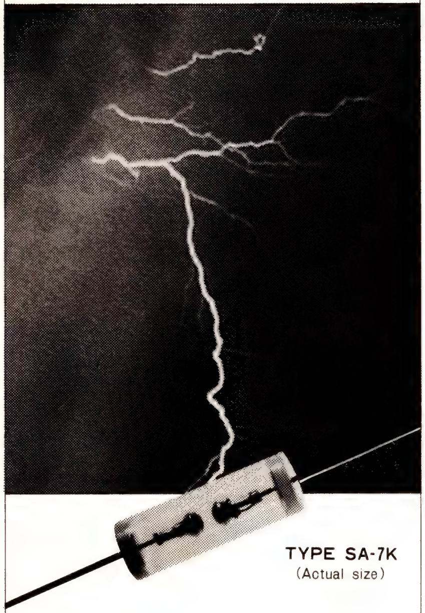

TYPE SA-7K
(Actual size)

● TYPE

Type	Breakdown Voltage (V) D	Insulation Resistance (Ω)	Maximum Surge Current (8×20us) KA	Life Times at 500A
SA-80SS	80±10%	10^{10} min	1.0	1000
SA-200SS	200±10%	10^{10} min	1.0	1000
SA-80	80±10%	10^{10} min	1.5	3000
SA-140	140±10%	10^{10} min	1.5	3000
SA-200	200±10%	10^{10} min	1.5	3000
SA-250	250±10%	10^{10} min	1.5	3000
SA-300	300±10%	10^{10} min	1.5	3000
SA-7K	7000±1000V	10^{10} min	—	5000
SA-10K	10000±1000V	10^{10} min	—	5000
SA-180D(3)	180±10%	10^{10} min	2.5	10000

SA-180D(3) is a three electrode discharge tube.
All tubes can be made dark effect redused types which are available upon request. D is added to the model number, as in SA-80DSS.

● POINT

(1)Usable at wider ambient condition, especially good under high humidity.
(2)Visibility for operation.
(3)Compact and easy assembly.
(4)Stable characteristics.

TYPE
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(Actual size)

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Meetings

Stride Faire '85, Stride Micro (Stride Micro, 4905 Energy Way, Reno, Nev. 89502), MGM Grand Hotel, Reno, Nevada, Feb. 8-10.

Optical Fiber Communication Conference, IEEE (Optical Society of America, 1816 Jefferson Place N.W., Washington, D.C. 20036), Town & Country Hotel, San Diego, Calif., Feb. 11-13.

Southern Telecommunications Showcase '85, United States Telecommunications Suppliers Assoc. (333 N. Michigan Ave., Suite 1618, Chicago, Ill. 60601), New Orleans Convention Center, New Orleans, Feb. 12-14.

The Golden Gate Metals and Welding Conference, American Society for Metals, *et al.* (Kim Mahin, Lawrence Livermore National Laboratory, P.O. Box 808, Livermore, Calif. 94550), Sheraton-Palace Hotel, San Francisco, Feb. 12-15.

International Solid-State Circuits Conference, IEEE (345 East 47 St., New York, N.Y. 10017), New York Hilton, New York, Feb. 13-15.

Third National Credit Committee Meeting, Electronic Industries Association (EIA, 2001 Eye St. N.W., Washington, D.C. 20006), Marriott Hotel and Marina, Ft. Lauderdale, Fla., Feb. 13-15.

PS-ASIA '85, American Federation of Information Processing Societies Inc. (AFIPS, 1899 Preston White Dr., Reston, Va. 22091), Tokyo, Osaka, Kitakyushu, Taipei, Hong Kong and Singapore; aboard m.v. World Wide Expo, Feb. 14-March 2.

Information Management Exposition & Conference, Cahners Exposition Group (Show Manager, INFO/CENTRA, 999 Summer St., Stamford, Conn. 06905), the O'Hare Exposition Center, Chicago, Feb. 20-22.

Computer Business Graphics, Frost & Sullivan (Carol Every, Industry Representative, Frost & Sullivan Inc., 106 Fulton St., New York, N.Y. 10038), Bonaventure InterContinental Hotel, Ft. Lauderdale, Fla., Feb. 20-23.

Macworld Exposition, World Expositions (World Expositions, Mitch Hall Associates, P.O. Box 860, Westwood, Mass. 02090), Brooks Hall, San Francisco, Feb. 21-23.

Automated Design and Engineering for Electronics Conference, Cahners Exposition Group (Michael Indovina, Cahners Exposition Group, Cahners Plaza, 1350 E. Touhy Avenue, P.O. Box 5060, Des Plaines, Ill. 60018), Anaheim Hilton and Towers, Anaheim, Calif., Feb. 26-28.

27th Israel Conference on Aviation and Astronautics, Israel Institute of Technology (M. Guelman, Chairman, Editorial Committee, c/o Department of Aeronautical Engineering, Technion—Israel Institute of Technology, Haifa 32000, Israel), Tel Aviv Hilton, Tel Aviv, and Technion, Haifa, Israel, Feb. 27-28.

1985 Eastern Simulation Conference, The Society for Computer Simulation (P.O. Box 2228, La Jolla, Calif. 94038), Omni International Hotel, Norfolk, Va., March 3-8.

Southwest Conference on Optics, Society of Photo-Optical Instrumentation Engineers (Sue Davis, SPIE, 10800 SE Eastmont Dr., Gresham, Ore. 97030), Albuquerque Convention Center, Albuquerque, N.M., March 4-8.

Seminars

Second Integrated Machine Loading/Material Handling Systems Seminar, Society of Manufacturing Engineers (SME, One SME Dr., P.O. Box 930, Dearborn, Mich. 48121), Holiday Inn Livonia-West, Livonia, Mich., Feb. 19-21.

High-Tech '85 Digital Equipment Exhibit and Seminar, Midwest Digital Equipment Exhibit (John Bastys, Countryman Associates, 1821 University Ave., St. Paul, Minn. 55104), Thunderbird Motel, Bloomington, Minn., Feb. 26-27.

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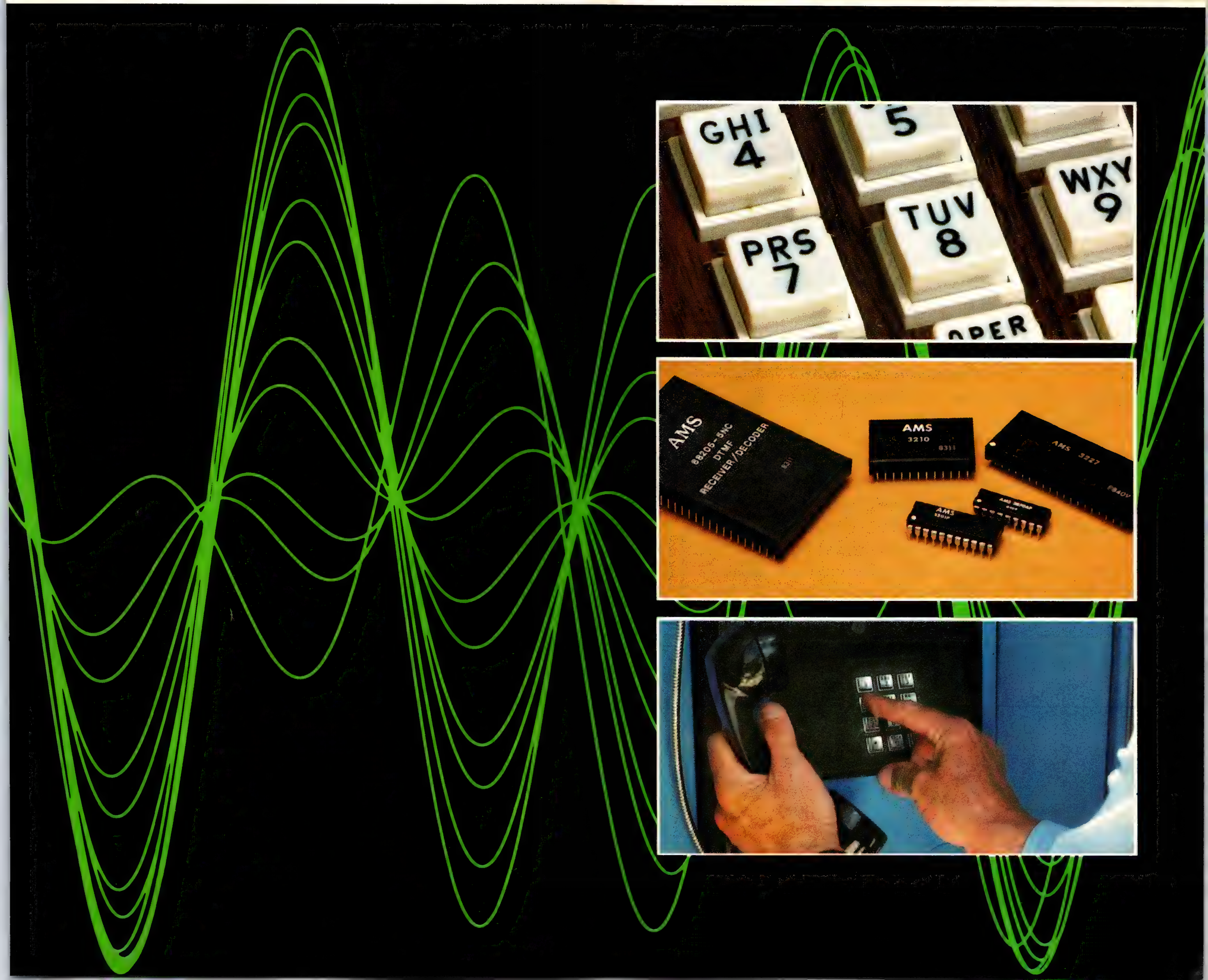
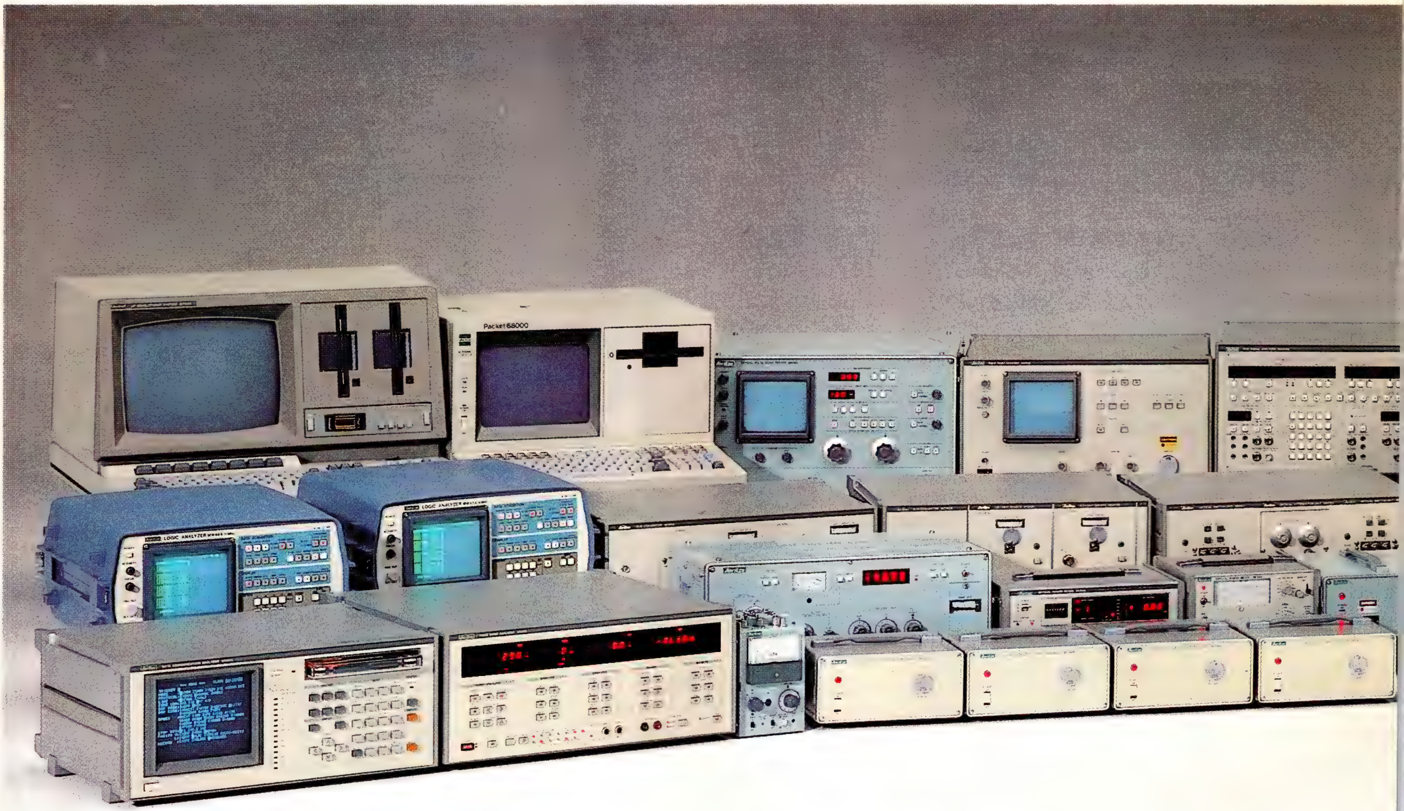


Better Instruments for Better Communications



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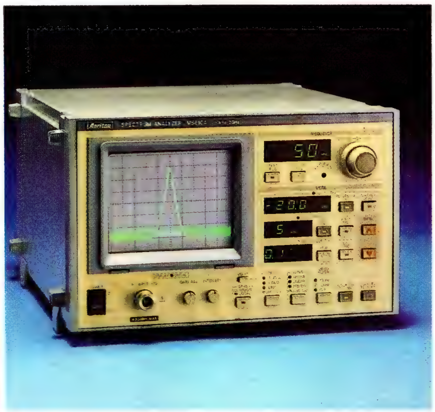

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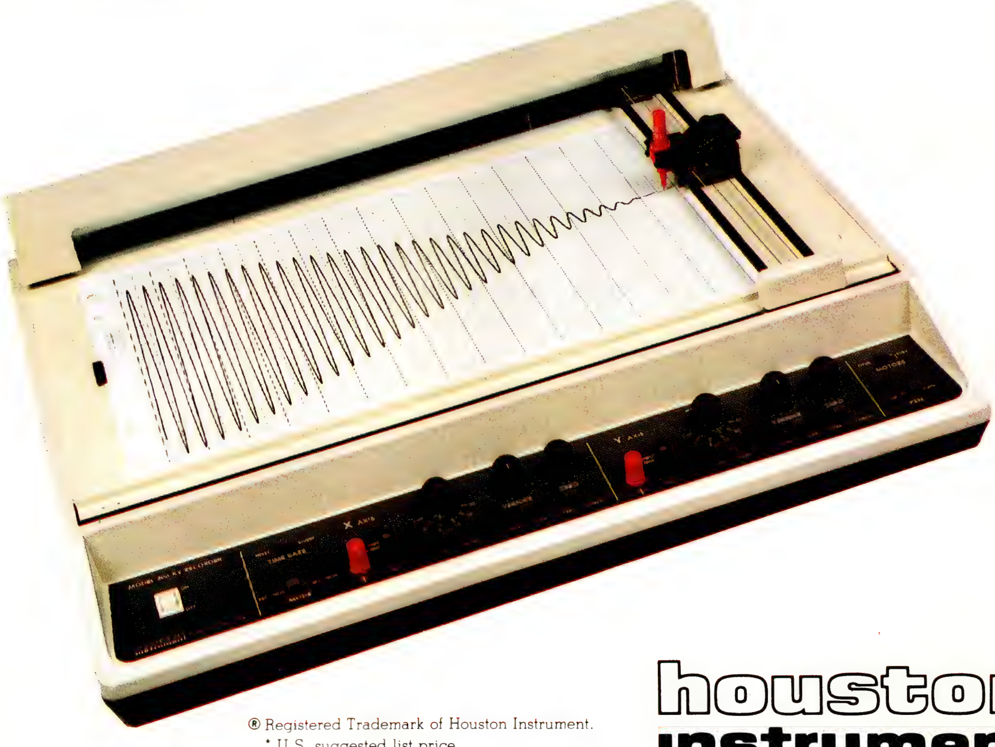

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AROUND THE WORLD

CMOS CHIPS MAKE A 'HYBRID'

Toshiba speeds design of semicustom circuits by utilizing standard CMOS chips as if they were hybrid-circuit components

☐ *by Charles L. Cohen*

Tokyo

Jumbo cells are already gracing the libraries of leading-edge suppliers of semicustom chips in the U.S. and Europe. In Japan, Toshiba Corp. has decided to follow suit in a unique fashion.

Instead of designing a suite of macrocells that can be interconnected on a chip to fabricate a monolithic system, Toshiba utilizes the masks for existing CMOS large-scale integrated circuits. It puts several of them on a single chip and then treats them as if they were components on a hybrid circuit, interconnecting them through a second layer of metallization.

At first glance, it might seem that any serious chip maker could get into the market with similar chips—which Toshiba calls super integration, or SI, chips. Several will probably try, starting with Tokyo neighbors NEC Corp. and Hitachi Ltd. in two or three years, thinks Shigeru Takizawa, senior manager of the firm's Logic IC/LSI Application Engineering Department.

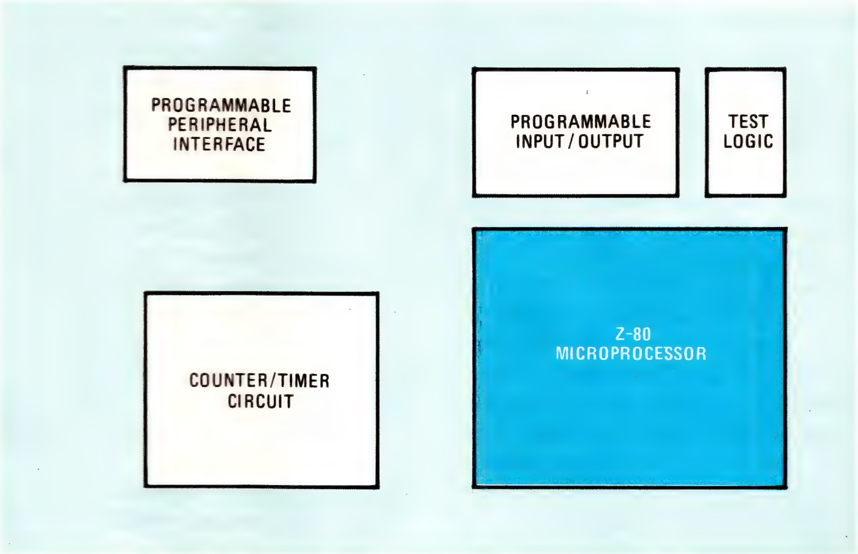
He says Toshiba was able to grab the lead because it was the first to complete development of a 4-MHz CMOS Z-80, the necessary peripheral circuits, and a full line of CMOS logic circuits; these pieces also all have the same gate-threshold margins, so they can be incorporated on the same chip. Moreover, the firm has developed the computer-aided-design software necessary for the design, simulation, and verification work prior to production.

Although other Japanese semiconductor manufacturers maintain that they have the technological prowess to duplicate Toshiba's new SI's, a quick survey indicates that none has made the preparations required to achieve the fast turnaround and low production cost essential for the success of this type of product.

Crossover in sight. For example, at Sharp Corp. in Osaka, Hiromitsu Takeuchi, general manager in Engineering Department 3, IC Division, says that he has been familiar with Toshiba's devices for some time because Toshiba has pitched them to some of Sharp's customers. Takeuchi feels that in a year or so there will be a crossover in costs, forcing his firm to develop similar devices. At the moment, though, lower yield of the SI chips and lower flexibility translate into higher costs, says Takeuchi.

Although not familiar with Toshiba's plans, Kenji Kani, engineering manager of NEC's Microcomputer Systems Department, notes that in broad outline they fit in with a worldwide trend: Microcomputer users can be satisfied with a single kind of core processor, but often want different peripherals on the chip. As yet, NEC has not considered a super-integration approach, but it is moving with the trend nonetheless. In its upcoming line of CMOS 16-bit microprocessors, the firm will offer versions with peripherals and chips that have central processing units only.

Toshiba confirmed its great expec-



Beginning a family. Toshiba's first SI chip has a Z-80 processor (lower block), a programmable peripheral interface (upper left), plus random logic and a clock circuit (upper right).

tations the first time it tried the SI approach for a product, reports Takizawa. His department designed and fabricated a "microengine" chip for a portable computer. It worked on the first pass, but potential customers, who had built chip-rework time into their planning, were not ready to use it.

Takizawa maintains that the success of this first chip was not just luck. He says that operating devices can be expected from first-cut silicon because mask patterns, logic simulation, and test specifications already exist for the macrocells. He adds that as the underlying LSI chips are improved—by going to finer geometries, for example—the system chips can be bettered almost automatically.

Added metal layer. In the SI technique, complete mask patterns of component chips making up a system are arranged so that they fit on the larger SI system chip. A typical system might consist of a microprocessor, one or more peripheral large-scale chips, and high-speed CMOS equivalents of the handful of random-logic TTL glue circuits.

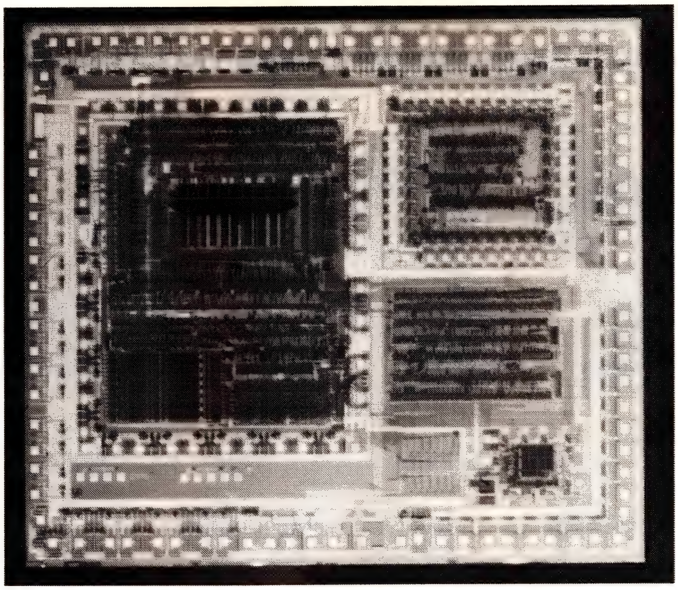
Because component chips are interconnected on the completed chip, additional CMOS circuits are included in order to facilitate testing. When a given component chip is being tested, the added circuits hold the others off.

Fabrication of the wafers for the SI's follows the usual steps for fabrication of the component chips, including the metallized interconnections on the component chips. The random logic is implemented from standard cells, derived from high-speed CMOS logic, in the same process. Then a layer of silicon dioxide is applied to the wafers, contact holes are opened, and interconnections between the component chips and the SI chip-bonding pads are fabricated.

Takizawa says that with today's high-performance computer-aided-design systems, the layout of the system wiring can be completed in an hour. Designing the random logic is also simpler and faster because its complexity is low and no attempt is made to achieve a high-density layout. Thermal considerations can be dispensed with because all the circuits are CMOS designs that dissipate negligible amounts of heat, even at the systems level.

Design time is also speeded because only a few macrocells are used in an SI, making the system chip easy to lay out. What's more, the separate level of metal for interconnection further simplifies design, because circuitous interconnection lines are at a minimum. Thus, production of a system chip can start within five to six months after the start of the project. This compares with a gestation time of two to three months for gate arrays, and 12 to 16 months for full custom chips.

Constantly shrinking. Another advantage of the standard-part macrocells is that the standard parts themselves are constantly being shrunk for better economy and higher speed. For example, the CMOS Z-80 currently uses 2.6-μm design rules and works at clock frequencies up to 4 MHz, but sometime during the first quarter of this year it will be available with 2.2-μm design rules for operation at clock frequencies up to 6 MHz. This constant updating of the technology is available with no effort on the part the group doing custom designs. It also makes it possible to add more functions to future components without changing the size of the chip.



Chunky chip. Super integration chip in development at Toshiba sports a Z-80 processor and three other large blocks: a counter/timer, a programmable peripheral interface, and programmable I/O.

Toshiba's first SI product, the MSX microengine, was originally intended for MSX-compatible computers [*Electronics*, June 30, 1983, p. 48]. However, the chip initially will be used in portable computers built to run other other software. The chips are scheduled to hit the market next month. MSX computers using the component are expected to come along in May; their introduction has been delayed because MSX computers are not selling as quickly as originally expected.

The microengine includes Toshiba's CMOS versions of the Zilog Z-80 microprocessor and Intel Corp.'s 8255 programmable peripheral interface, as well as Toshiba's own T6497 clock generator and the equivalent of about 100 high-speed CMOS versions of TTL packages on a 7.6-by-8.2-mm chip. There are also standard CMOS buffer circuits alongside the bonding pads of the part.

Extra functions. Ordinarily, an MSX computer contains only about 20 TTL packages—including memory control, slot control, and printer control—but more functions were added for the microengine, and additional circuits are needed for the special test capabilities.

The MSX microengine costs about $8 in original-equipment-manufacturer quantities, but it replaces a CMOS Z-80, a programmable peripheral interface, and a clock generator, which total about $5 in OEM quantities, as well as logic ICs, which would add another $12 or so to the bill. Moreover, the microengine makes it possible to replace a letter-size, $12 printed-circuit board with a business-card-size board costing perhaps one tenth as much.

Takizawa says that Toshiba is now developing about 10 SI chips for applications including personal computer peripherals, printer controllers, office-automation work stations, electronic typewriters, word processors, and musical instruments.

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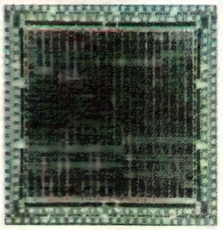

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JUST PIE IN THE SKY?

Suspicions, doubts, and uncertainties mark U.S.'s entry into the Japanese satellite market

☐ *by Michael Berger, McGraw-Hill World News*

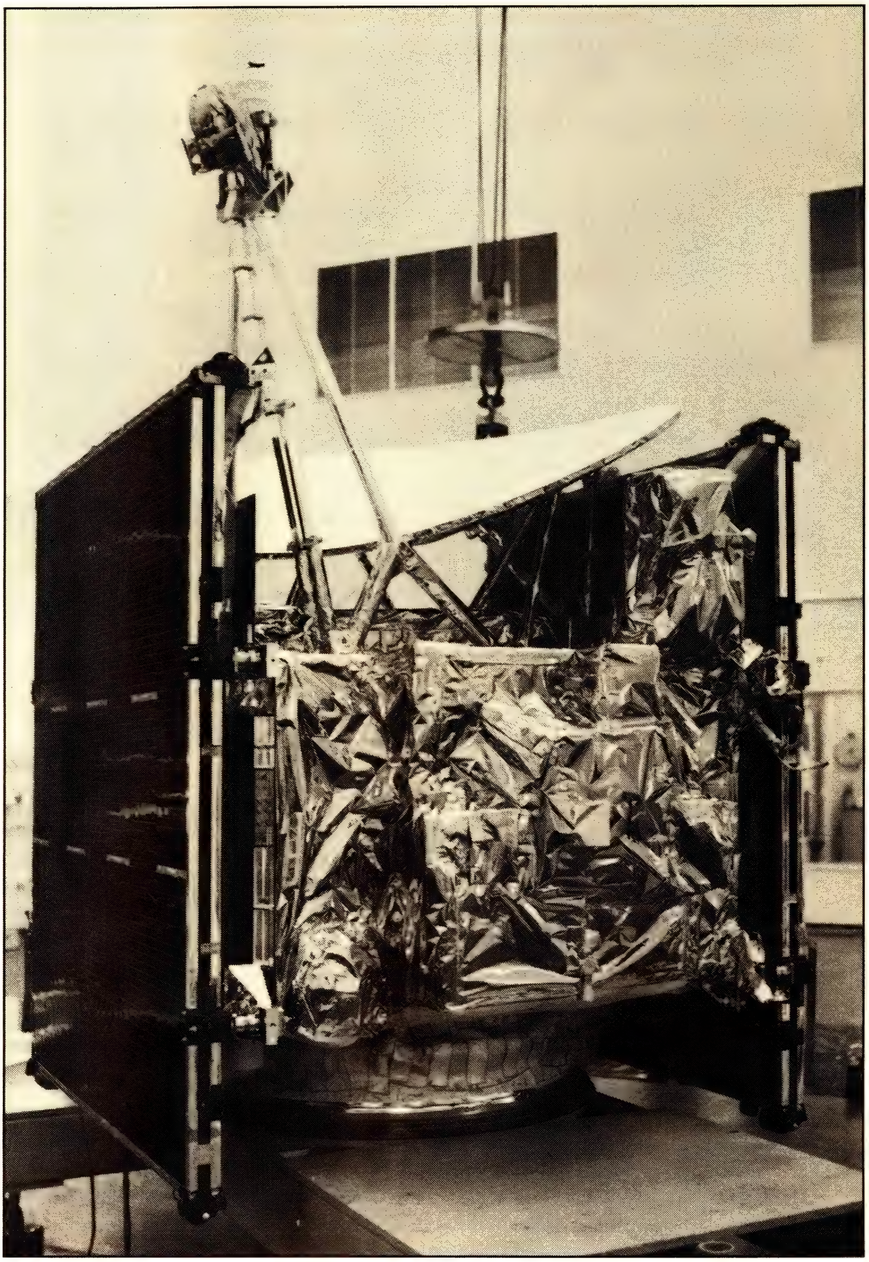
Tokyo

Although U.S. satellite makers are cautious about their Japanese market possibilities, and even voice fears that the Japanese may only be shopping in order to leapfrog U.S. technology, they are forging new market ties to exploit whatever opportunities exist when new telecommunications laws go into effect April 1 (see "Satellite angels don't fear to tread," p. 21). One of the laws will lift the ban on the purchase of foreign-made satellites; another will allow private satellite networks to be established for the first time.

Three U.S. satellite producers have Japanese ventures, and two of them—Ford Aerospace & Communications Corp. and RCA Astro-Electronics Corp.—have announced link-ups in recent days. But none of the trio (Hughes Aircraft Corp. is also entering the market) is certain just how lucrative Japanese sales will eventually be.

Dominance reversed. One thing is sure: A market that was dominated 100% by U.S. technology 15 years ago is now at least 60% in the hands of Japanese companies, and in the wake of a U.S.-Japan trade deficit in telecommunications that is expected to top $1 billion in 1984, every market segment, including satellites, will probably be investigated from the U.S. side for possible trade barriers.

The question that has yet to be



Up in the air. Whether or not U.S. firms have a future in collaborating on Japanese satellites—such as this television broadcasting relay—is still debatable.

answered, however, is how much foreign participation there will be in all these new businesses. Even as he announced a U.S.-Japan linkup at a Tokyo symposium on communications satellites, Charles A. Schmidt, vice president and general manager of RCA's Government Systems Division, Morristown, N.J., sounded a warning. "First and foremost, we want to sell a satellite in Japan, but what's the Japanese government's real game plan? As we make technology available, are we helping a business partner or a future competitor?" Schmidt said.

Squeeze feared. Along with other U.S. space industry executives, he worries that a premise of Japan's space development program—the need for that country to develop its own technology in the field—will leave little or no room for future cooperation with foreign firms.

Another question is how flexible or realistic the Japanese bureaucracy will be in administering the satellite market. "You have to wonder whether some Japanese want this new system to work or not," says Albert D. Wheelon, group president of Hughes's Space and Communications Group.

Wheelon, who also spoke at the Tokyo symposium, was referring to a Ministry of Posts and Telecommunications (MPT) decision to allocate all communications-satellite operations to the 20-30 GHz Ka band. "Some Japanese seem to have the idea that the Ka band has a great future, so they want to be in the forefront of that technology. But at present, there is no world Ka market," Wheelon said.

One reason is that the Ka band is 10 times more susceptible to bad weather than the more commonly used 12-to-14-GHz Ku band. In addition, to overcome this obstacle, two earth stations rather than one are needed, with a switching station in between to select the stronger signal in inclement weather. This factor alone doubles the cost of Ka-system operation.

Hughes and its Japanese partners, the two giant trading firms Mitsui & Co. of Tokyo, and C. Itoh & Co. of Osaka, have been lobbying the Japanese government for many weeks to sway MPT to drop its Ka-band-only approach, and to allow allocations within the Ku band. A study to reexamine the subject has been undertaken, and sources close to the negotiations expect an MPT announcement within the next two months. A decision against Ku-band allocation would make Hughes's Japanese venture "a lot less attractive to us financially," Wheelon said.

The U.S. companies aren't alone on this issue. In addition to their trading company partners, who are eager to muscle into any new market they can find, other heavy hitters are battling the government. The Federation of Economic Organizations (Keidanren), which wants to operate its own business-satellite communications system, opposes the government plan, and so does Fujitsu, Ltd., which is heavily involved in satellite ground-station development. The company fears that an over-commitment to the Ka band will widen the telecommunications technology gap between Japan and the U.S.

Government involved. U.S. executives are cautious about predicting how large the market may be. "This is not just a trade or technology issue, it's also a bureaucratic turf fight," said one U.S. executive. MPT, which in the past lost influence when its offshoot, Nippon Telegraph & Telephone Public Corp. (NTT), was formed, is determined to wield great influence in a Japanese telecommunications market, which by conservative estimates will be worth more than $8 billion by 1987.

Despite the rational arguments by the U.S. side and its Japanese supporters for a flexibly administered market, the bureaucrats might decide that retaining or extending their power is more important.

The satellite market issue also is linked to a question of national prestige. "If we cannot develop and control our own space technology, Japan will become a second-rank country," Tadahiro Sekimoto, president of NEC Corp., told the symposium.

"They can go it alone if they wish," says William Rapp, commercial counselor at the U.S. Embassy in Tokyo. "But if they do, it will be at a very high cost. It will take them years to develop sophisticated systems that they could purchase right now. Japan cannot climb into the top ranks of the so-called information society with a telecommunications system that is too expensive."

Satellite angels don't fear to tread

Although some U.S. electronics executives have voiced uncertainties and misgivings about forming joint satellite ventures with Japanese firms, some of the largest U.S. corporations have already stepped forth boldly to claim whatever share they can wrest from this still-controversial market.

Announced last month was a venture to be undertaken by RCA Astro-Electronics Corp., Hightstown, N.J., and Tokyo's Sony Corp., aimed at both components and satellite systems. Ford Aerospace's agreement with Mitsubishi Electric and Mitsubishi Corp. is for the manufacture and sale of half-ton and one-ton satellite systems for both the domestic Japanese and world markets. The purpose, both parties say, is to use those techniques in which each is most skillful—for example, Ford in one-ton systems, Mitsubishi in half-ton—to manufacture the most price-competitive equipment possible. Mitsubishi Electric Corp. of Tokyo, which dominates Japan's domestic satellite market, has had a cooperative technical agreement with Ford Aerospace & Communications Corp. of Detroit since 1971.

The new Ford-Mitsubishi venture puts the firms in direct competition with a third U.S.-Japan linkup, which involves Hughes Aircraft Co., Culver City, Calif., and two large trading houses, C. Itoh & Co., Higashiku, Osaka, and Mitsui & Co., Tokyo. The Hughes-Itoh-Mitsui group aims to manufacture, launch, and sell services on a business communications satellite network, which would be operating by 1988.

One of the prime customers will be Japan's Federation of Economic Organizations. Keidanren, as it is called, also organized a satellite broadcasting company last month, which by early 1989 would provide TV programs to homes with parabolic antennas, as well as high-fidelity television, pulse-code modulation radio, and other broadcasts. **–M.B.**

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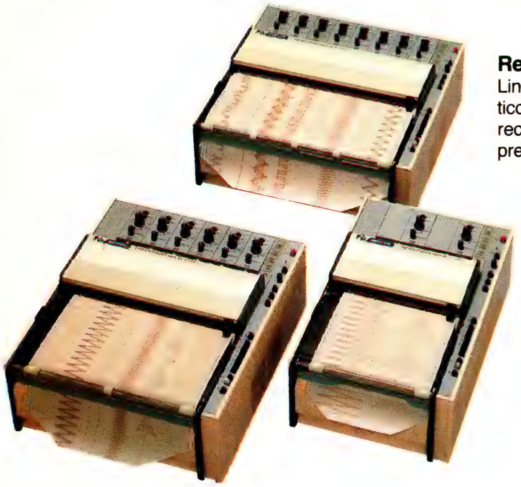

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LASER TESTS GaAs DEVICES

Palo Alto

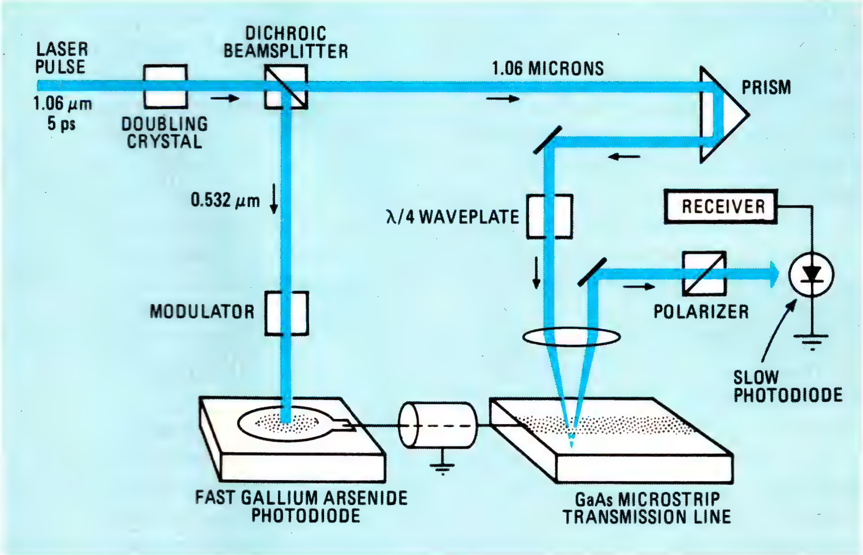
High-speed gallium arsenide integrated circuits are progressing at a pace that has brought them to the performance frontiers of test instrumentation. State-of-the-art sampling oscilloscopes reach their limit at about 10 GHz, and spectrum analyzers have a maximum level of about 20 GHz. Although this is sufficient for GaAs chips at the moment, it won't be for long. GaAs devices are poised for a leap upward in frequency; indeed, some experimental parts are already in existence that have speeds of more than 100 GHz.

One candidate for a general-purpose research tool that can handle the high speeds in sight for GaAs integrated circuits is being developed at Stanford University. At Stanford, researchers have used a neodymium-doped yttrium-aluminum-garnet laser to measure GaAs switching frequencies and electric fields noninvasively at sampling rates of 1.8 ps.

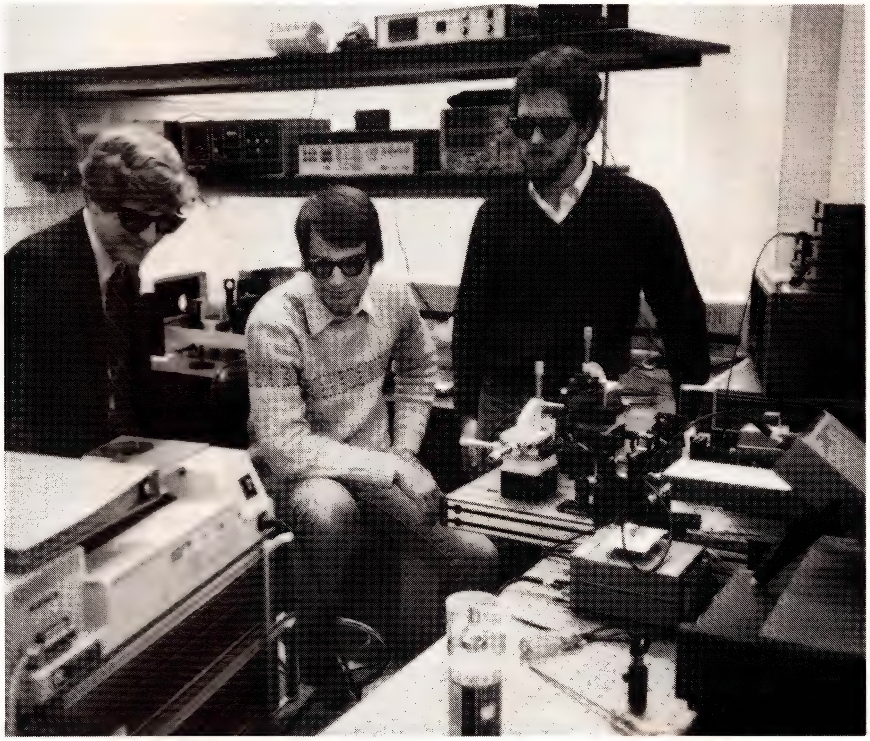
At that speed, the sensitivity level is 22 μV/Hz. The researchers involved in the project say they foresee no difficulty in pushing the resolution to under 1 ps (which would correspond to parts with bandwidths over 100 GHz). At the same time, they expect to improve the sensitivity to under 1 μV.

Serendipity. The technique is based on a serendipitous discovery: Because GaAs exhibits a photoelectric effect, it mates well with laser research. When illuminated by a laser beam, GaAs generates an electric field. The field, in turn, changes the material's birefringence, or the relation of its index of refraction to the polarization of a light wave passing through it. Changing the polarization results in a change of the intensity of the light beam; and by measuring the difference in intensity it is possible to determine the shape of the electrical signal triggered by the beam.

David M. Bloom, a professor in Stanford's electrical engineering department, and several graduate students have built on earlier work at AT&T Bell Laboratories Inc., Short Hills, N.J., and the University of Rochester, in New York, in order to take advantage of this effect in making their high-speed measurements. Bell developed a method of mapping an electrical pulse by measuring the



Fast check. A laser-beam pulse of 1.8 ps is split into two parts, one directed to a GaAs photodiode and the other to a transmission line that functions as the active element in a Pockels cell. This setup can sample the photodiode's output signal because it varies the intensity of the light that reaches the slow photodiode.



Laser-light touch. Stanford professor David Bloom (left) and graduate students Brian Kolner and Kurt Weingarten (right) use an Nd:YAG laser and a microstrip transmission line to characterize GaAs devices.

response of a photoconductor.

Researchers at Rochester refined this basic technique by illuminating the photoconductor with a split laser beam. They also set up a delay between the time that the first and second parts of the beam reached the photoconductor. By sampling the amplitude of the received signal, the Rochester group derived the shape of the electrical pulse. A 300-μm difference in the transmission path of the two beams corresponds to a 1-ps time difference.

Characterization. The Stanford group has developed a compression technique for obtaining the 1.8-ps pulses, and has adapted the process for characterizing semiconductors, exciting a photodetector, and then sampling the signal. The same team has also performed frequency analysis from harmonics obtained by using the fast pulse train to sample a microwave source.

Combining sampling and harmonic mixing provides characterization in both frequency and time domains. Bloom expects the measuring technique to be used at first as a development and debugging tool. But ultimately, he says, it offers promise for high-speed testing using on-chip photodetectors.

The Stanford experiments were performed on discrete GaAs components. Bloom says that a custom high-speed chip is being developed by Hewlett-Packard Co., located nearby, where Bloom once worked as a researcher. Other companies are also interested, including Varian Associates, another Palo Alto firm, which is working on a 20-GHz FET amplifier.

"Gallium arsenide is becoming popular," Bloom asserts. "Some companies are moving their people involved in silicon very-large-scale-integration into their gallium-arsenide effort."

Spectra-Physics Corp., Mountain View, Calif., has already derived a concrete benefit from the Stanford research. After helping the Bloom group perform pulse compression on the Nd:YAG laser, the firm turned the technique into a product: a fiber-grating pulse compressor rated at 5 ps. Dye lasers would be faster, but the company maintains its model 3600 is the first picosecond solid-state instrument. **–Clifford Barney**

News Briefs

Bell Labs sets production of 1-Mb DRAMs

AT&T Bell Laboratories plans to begin manufacturing its 1-megabit dynamic-RAM chip in quantity within the year and says it expects to be in full production at its Allentown, Pa., facility in 1986. The chip requires only half the operating power of AT&T's 256-K dynamic RAM, which it began selling to selected commercial customers in early 1984, and can access memory cells in 80 ns. AT&T's ability to produce defect-free chips in large quantities is seen as crucial to its commercial success in a memory market where it remains relatively untested. Although IBM, Hitachi, Fujitsu, and NEC have all completed 1-Mb designs, AT&T is the only memory-maker to announce that it is close to volume production. The chip will be used in the firm's PBXs, digital switches, computers, and modular signal processors, AT&T says, but it remains unclear whether it will be available to outside customers.

Sanyo to market 8-mm video in U.S.

Sanyo Electric Co., Moriguchi City, Japan, will be the first Japanese manufacturer to sell 8-mm video cassette recorders with its own brand name in the U.S. The company plans to exhibit the VCR at the Winter Consumer Electronics Show in Las Vegas and is ready to ship orders received there, but won't yet reveal price and specifications. Sanyo notes that its VCR is not the one-piece camcorder favored by other firms, but a separate VCR with a tuner that locks onto the recorder for off-the-air recording. The firm originally had contemplated marketing the 8-mm VCR in time for Christmas sales, but didn't want to be accused of wrecking the important year-end market for ½-in. VCRs.

Casio unveils LCD color TV

Another star at the Consumer Electronics Show will be Casio Computer Co.'s 2.6-in. liquid-crystal-display color TV—priced at $299.50 in the U.S.—and a $99.50 2-in. black and white LCD TV. Sales are tentatively scheduled to start in April. The Tokyo firm says its passive-matrix display can be made cheaper than the Seiko active-matrix display used on Japan's first LCD color TV, although the viewing angle is smaller and a built-in fluorescent backlight is needed indoors for the color set. Ambient light transilluminates the display panel and the image is viewed through a mirror, a scheme first used by Citizen Watch Co.

IBM to grant academia $25 million for research

Saying it is seeking to promote technological innovation through basic research rather than producing new materials and technologies for its own use, IBM Corp., Armonk, N.Y., has announced a $25 million grant program to graduate-level research over a five-year period in the materials and processing sciences at a dozen universities. The 12 grants of up to $1 million each are also earmarked for creating tenured faculty positions and developing new graduate courses in materials and processing research, polymer research, and developing interfaces between dissimiliar surfaces, such as polymers and metals. Recipients would also get to keep $1 million in IBM equipment, including computers, software, and molecular-level measurement devices. Initial proposals are due in April; IBM will announce the 12 winners in March 1986.

Japanese data-base copyright proposal causes controversy

Battle lines have already been drawn after the first attempt by the Japanese government to move on copyrighting data bases. The Japan Copyright Council, an advisory body of the Ministry of Education, has recommended that data bases stored on magnetic disks, tapes, and other media for computers should be protected by the Copyright Law as creative works, just as literary, musical, and artistic works are. The council has excluded, however, consideration of computer software. The powerful Ministry of International Trade and Industry has also been studying the idea of protecting data bases, but insists that the originators of new media products, and also the authors of software and other information-related products, should be protected by new laws.

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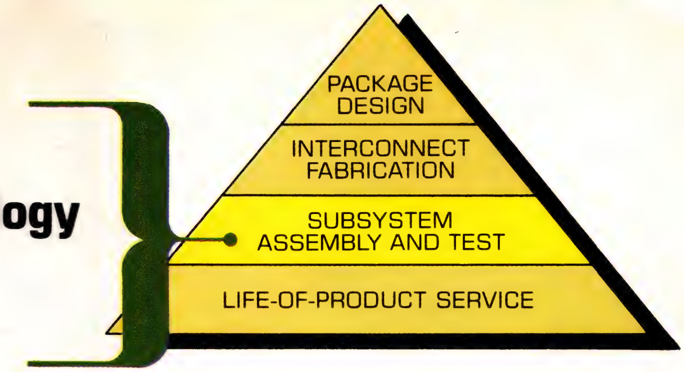

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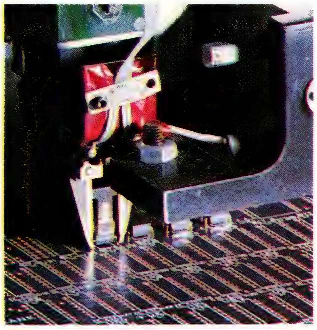

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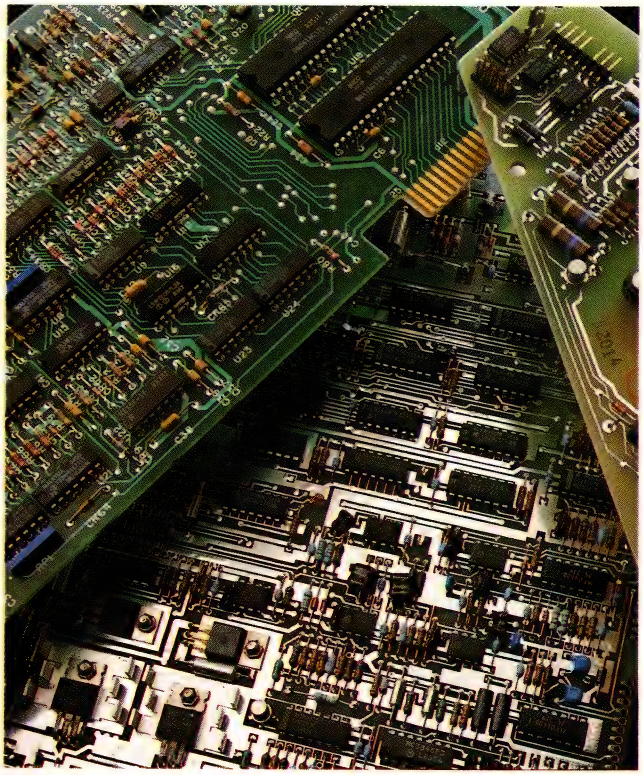

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ULTRABRIGHT FAMILY FOR BACKLIGHTING

SIZE	COLOR	DEVICES	$2\Theta^{1/2}$	$^{**}I_{v\ TYP}$
T-1 3/4	Red Yellow Green	HLMP-3750, MV3750* HLMP-3850, MV3350* HLMP-3950, MV3450*	24°	150 mcd
T-1	Red Yellow Green	HLMP-1340 HLMP-1440 HLMP-1540	40°	60 mcd

*Without Stand-Off **At 20 mA

Typical brightness is 60 mcd in T-1 and 150 mcd in T-1 3/4, both at 20 mA.

They're available in red, yellow and green in T-1 and T-1 3/4 water-clear packages. And they're pin-for-pin replacements for HP products at a substantially lower cost.

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2 mA FAMILY FOR DIRECT VIEW STATUS INDICATION

SIZE	COLOR	DEVICES	$2\Theta^{1/2}$	$^{**}I_{v\ TYP}$
T-1 3/4	Red Yellow Green	HLMP-4700 HLMP-4719 MV2454*	50°	3.0 mcd
T-1	Red Yellow	HLMP-1700 HLMP-1719	50°	4.0 mcd

*At 3.5 mA 35° **At 2.0 mA

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CHIP TO CARRY ERROR-CORRECT CODE

Houston

In one-way satellite transmission, a missing link is a good thing. Systems cost less to operate when they do not need a second link to handle retransmission requests from receiving earth stations.

Such systems, however, require highly reliable transmission, free of errors caused by noise or link interference. To guarantee that—at a reasonable cost—a Houston startup company called Space Research Technology Inc. is readying a new approach to forward error-correction coding.

The firm's half-rate short-block coding technique is guaranteed to fix as many as three erroneous information bits per 24-bit word. It also eliminates acquisition-cycle delays, which trouble users not operating on a dedicated satellite link. Consequently, the company believes its error-correction coding will help the sluggish commercial satellite industry compete against terrestrial digital transmission lines, which keep getting faster and more accessible.

Ben L. Midulla, president and cofounder of Space Research Technology, expects the new coding technique to find a home in a variety of other digital voice/data applications such as cellular radio telephone and modem computer networks over phone lines. But the biggest impact, Midulla hopes, will be in providing reliable one-way satellite communications for many commercial customers, who are often switched from link to link during transmissions.

One such potential user, Merrill Lynch & Co. Inc., New York, is looking for a way to use switched satellite channels and direct broadcast to dispatch data to field offices. This would not be practical if the receiving station had to request retransmission of bad data, he adds.

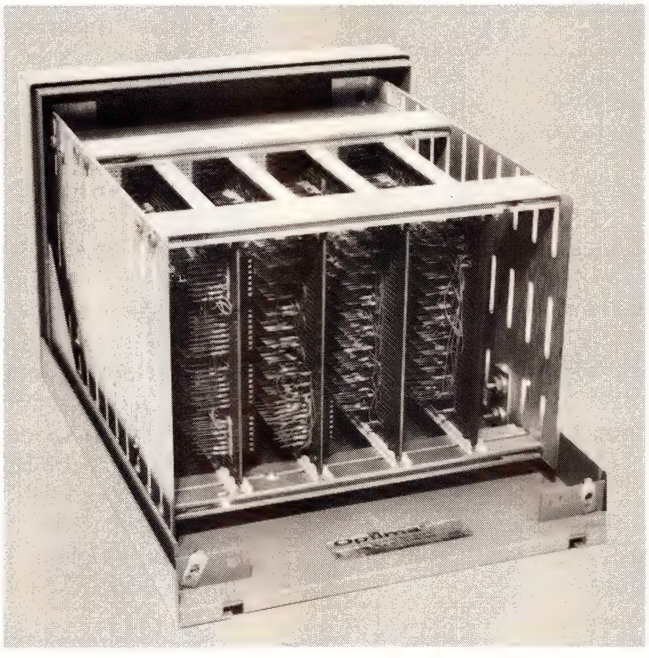
Contrary to expectations, commercial satellite transmission markets have not reached the heights that carriers had hoped for in recent years, says Linda Lee Bower, an international telecommunications consultant for Frost & Sullivan Inc., New York. But Bower expects the emergence of commercial direct-broadcast markets to propel growth rates in the North American market.

A recent Frost & Sullivan study shows transmission revenues at North American firms that launch and operate satellites were $606 million in 1984 and are expected to hit $906 million in 1985. That figure is projected to be $2.5 billion by 1990.

Crucial circuits. The way to lower-cost error-correction coding is to make the implementation simple enough to pack all of the processing circuitry into one very large-scale integrated circuit, explains George D. Doland, cofounder of Space Research Technology and architect of the proprietary 24-bit block-coding scheme. That means using a short-block coding technique rather than the more common, but complex, convolutional error-correction coding.

Declining to detail the approach, Doland says his block-coding scheme is similar to an extended Golay code, which bundles a redundant 12 bits of checking-and-correcting data with every 12 bits of information. This approach enables the system to correct single-, double-, and triple-bit errors in the 12-bit information word.

Doubled rate. An engineering prototype of Space Research Technology's 24-12-03 hard-decision decoder system has already shown that the new coding technique can allow users to double their digital transmission rates without increasing received errors, or to cut the chance of errors by a factor of 1,000 when normally operating at one error per million bits. The code could also prove to be a boost for small-dish direct-broadcast operation because errors are not increased when signal levels are reduced by a 2:1 ratio.



Ready for shrink. The 100 or so medium-scale integration packages in Space Research Technology's prototype error-correction-code gear will be packed into a single VLSI circuit in the production version. It will be ready in the third quarter of 1985.

VLSI Technology Inc.'s design center in Austin, Texas, is handling the codec design. The 68-pin CMOS chip will hold some 48 parity generators, plus 32-bit counters, shift registers, flip-flops, and assorted glue logic. In all, the VLSI chip will encompass the functions of about 100 of the medium-scale integrated circuits in the prototype box (see photo). Memory modules will contain the software for the error-correcting algorithms.

Slated for volume production this summer, the hardware will be sold in three forms: components, priced at $500 per chip set in large quantities; modules on boards, at $1,200; and a turnkey codec system, at $2,500. Production units will operate at up to 2.5 Mb/s. –**J. Robert Lineback**

PHILIPS USES MBE FOR LASERS

Redhill, England

Visible-light-emitting laser diodes are notoriously difficult to fabricate by conventional means, so a research team at the Philips Research Laboratory here has turned to molecular-beam epitaxy to make these components. They have used the technology to lay down an active region a few atomic layers thick, allowing them to tailor the band gap to get the desired radiant wavelength.

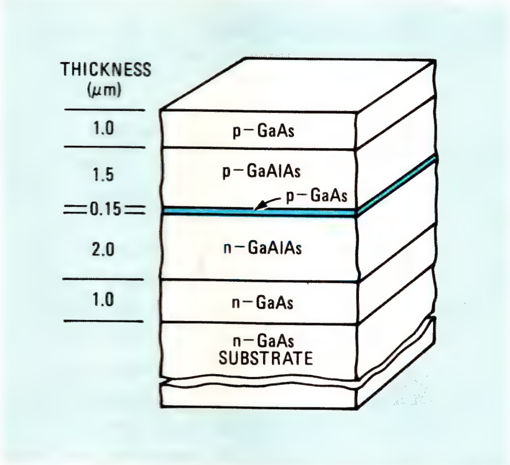
The Philips team, led by John Orton, has fabricated multiquantum-well lasers, in which the active layer of ultrapure gallium arsenide is a mere five atomic layers thick, or just 13 Å. They operate at the short wavelength of 710 nm, compared with 880 nm in conventional GaAs lasers.

Expensive art. The atomically proportioned layers in the new lasers are formed by the expensive art of molecular-beam epitaxy, a process developed by AT&T Bell Laboratories. Philips, though, should be among the first to utilize quantum-well lasers in real systems, although team leader Orton stresses that these first parts are purely experimental.

Be that as it may, MBE-made laser chips are strong candidates to replace visible-light-emitting laser diodes made by liquid-phase epitaxy. To make these diodes glow red, the active GaAs layer, about 500 Å thick, is infused with aluminum. But that impairs reliability and makes manufacturing tricky. In fact, the components group of parent company N.V. Philips, of Eindhoven, the Netherlands, reportedly ran into severe production problems; industry sources say that the firm's entire compact-disk program was held up by a shortage of laser diodes and is only rolling now because Japanese-made parts became available.

Laser diodes in the compact disk operate at either 820 or 780 nm. The video disk and mass-data-storage digital disk, however, use a helium-neon laser operating at an even shorter wavelength of 630 nm. Thus, any solid-state replacement will have to operate at even shorter wavelengths than in the compact disk. Philips researchers believe MBE is the most likely candidate to fabricate lasers that can do this.

Of course, MBE is not the only method available. One alternative is metal-organic chemical-vapor deposition (MOCVD), favored by France's Thomson-CSF and several Japanese companies [*ElectronicsWeek,* Nov. 26, 1984, p. 17]. This route is also being taken by the Plessey Co. plc and STL Laboratories in the UK, while the General Electric Co. plc, a late starter, is using both methods.



Thinned down. By using molecular-beam expitaxy, Philips researchers can fabricate AlGaAs lasers having active regions just a few atomic layers thick.

"MOCVD may be better for thicker layers, but for ultrathin layers, MBE wins out on controllability," says Bruce Joyce, a member of the Philips team. "Japanese companies are buying MBE gear in quantity," he continues.

Tailored structures. Both of these techniques have come to the fore in solid-state research because they open the door to novel man-made structures, tailored to produce electron and optical properties not found in natural crystals. They can be used to make single-layer quantum-well structures or complex sandwich structures with 100 or more layers.

In MBE processing, the target—a GaAs wafer—is placed at one end of the MBE chamber. At at the other end of the chamber are a number of small electric furnaces, one for each source material. For example, arsenic is heated to about 300°C, gallium to more than 1,000°C. These temperatures are chosen so that the Ga and As molecules, evaporated from the solid, have enough energy to zip across the vacuum cavity and condense onto the GaAs wafer, copying its crystal structure exactly.

To even out beam irregularities, the target is set spinning at 200 rpm. The molecular beams are switched on and off by fast-acting shutters and can be directed simultaneously or independently at the substrate. For example, a GaAs-AlGaAs structure can be grown by separate Al, As, and Ga beams, switching the Al beam on and off as needed.

Because this is a relatively low-temperature process, interdiffusion is not a problem, and thus extremely sharp composition profiles can be built up. It is also a speedy process: A single atomic layer is laid down every second, says Karl Woodbridge, the group's crystal-growing specialist. Each atomic layer is counted as it is formed by grazing an electron beam across the wafer and counting the fluctuations in its output.

Developed at the Philips labs, this Rheed oscillation technique is now widely used to monitor growth. Using this gear, Philips can now lay down layers just a few atoms thick. But as Philips' Joyce remarks, "Nature is on your side. The system wants to grow smooth surfaces."

To date, Philips has taken band-gap engineering techniques close to their theoretical limit, and has produced lasers operating at 710 nm. The process could be optimized even further by adding a low concentration of aluminum to the active zone; that could bring it within sight of the 680-nm target. **–Kevin Smith**

LARGE DISKS MAKE COMEBACK

Manufacturers take a hard second look at 5¼-in. Winchesters and decide that small is not necessarily beautiful

☐ *By Larry Waller*

Los Angeles

A funny thing about those red-hot 5¼-in. Winchester disk drives: They were ambushed on their way to taking over the 100-megabyte-plus storage needs of microcomputers. As recently as last summer, most suppliers had been telling the world that the new higher-capacity minidrives would soon establish a dominant position in the marketplace [*ElectronicsWeek,* July 23, 1984, p. 28].

But big customers, primarily original-equipment manufacturers, have decided otherwise. They are opting instead for the larger brother of the 5¼-in. size, the 8-in. Winchester, which even some of its suppliers had consigned to oblivion.

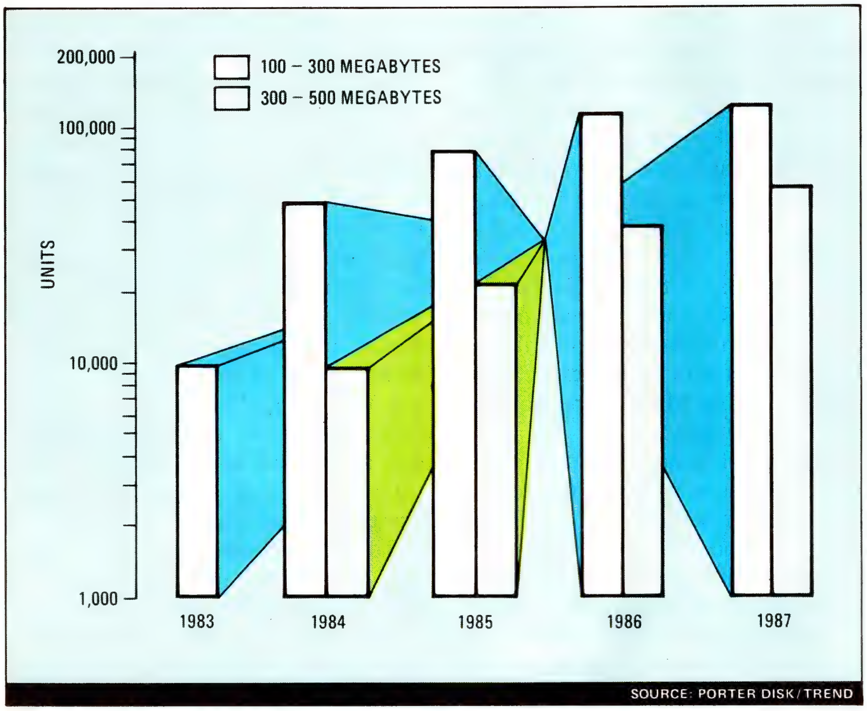
Whether termed a "counter-trend" or "repositioning," the move to 8-in. disks at the expense of the 5¼ has important implications both for suppliers of this key peripheral and for customers who are designing the next generation of work stations and computers. At the heart of the issue is a bedrock truth that evidently was overlooked by participants who knew better, but were distracted by 5¼-in. hype. It has to do with the market targets, the original-equipment manufacturers.

"The nature of OEMs is basically conservative," explains Keith Murphy, vice president for marketing at MegaVault Memories, Woodland Hills, Calif. "They welcome new technologies, but do not trust them until they have been proven."

A confessed "knee-jerk 5¼-in. believer" when he joined MegaVault, a specialist in 8-in. Winchesters, last June, Murphy soon changed his stripes as the results of an internal market study that he put together became clear. The essence of that study: "Far from being dead, as many claimed, 8-in. drives have a solid future."

First to arrive at this conclusion, during the spring of 1984, was Michael Gluck, vice president of Fujitsu America Inc.'s Storage Products Division in San Jose, Calif. Fujitsu itself has the best vantage point to oversee the 8-in. business, due to the success of its model M2322 168-megabyte drive, the top seller.

As Gluck recalls, "At the height of the 5¼-in. hysteria, we were one of the few who were extremely bullish on 8-in. Winchesters. To get more units manufactured, I had the job of going to Japan and convincing them that we were right. And while there was some concern, the situation was essentially the same there, so they agreed." Accordingly, Fujitsu has doubled its production for the U.S. since June, to several thou-



SOURCE: PORTER DISK/TREND

Still strong. Eight-inch Winchester drives in both high-capacity formats will continue to dominate the professional mass-storage market for the foreseeable future—gradually edging out the older 14-in. drives as users upgrade their computers and work stations.

sand a month, and will double production again by this June.

Fujitsu not only had momentum with the 8-in. drives, but also understood the smaller format through its own 5¼-in. entries. Thus, Gluck had no doubt that suppliers of the smaller products had bitten off more than they could chew with large capacities. "They were pressing technology to the margin," he notes.

With up to eight platters per drive, the manufacturing difficulties became too great. Also, thin-film and plated media were unreliable. These troubles were known to potential customers, who worried that even if suppliers got the large-capacity 5¼-in. drives into production, "they probably couldn't deliver in high volume," according to Gluck.

Quickly accessible. To understand fully the current status of large-capacity 5¼-in. drives, it must be noted that even those who hope to supply them admit that there is little product available in the volumes needed by big customers. This is true even for the 85-megabyte drives announced throughout the past year, but still in the sampling stage.

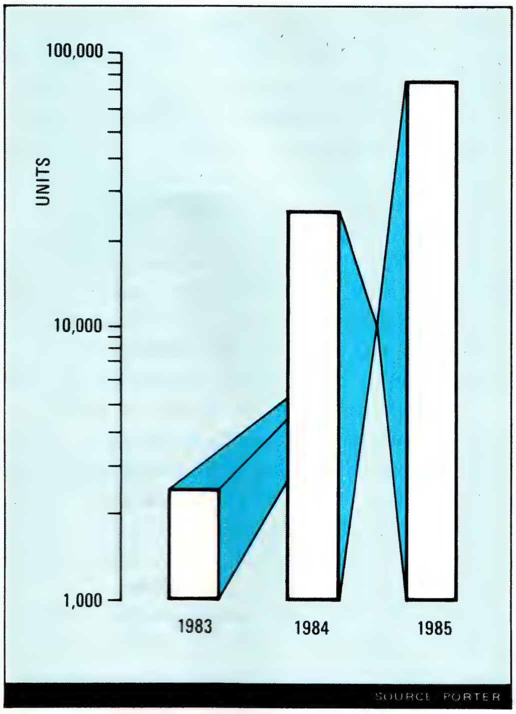
Indeed, the only true high-capacity 5¼-in. drive being turned out in quantity comes from Maxtor Corp., Santa Clara, Calif., whose model XT-1140's 140 megabytes of storage has been on the market for months. But 8-in. backers quickly point out that its slower access time (35 ms, on average) is a disadvantage against the 20 ms of proven 8-in. technology.

Fujitsu's Gluck, for one, claims that the speed disparity is something the smaller units will have a hard time overcoming. "Users want 20-ms access time because throughput is the name of the game—especially for the high-performance work stations now being designed," he says. In fact, throughput is so important that customers have gone to the lengths of redesigning computer and work station cabinets to accommodate the 8-in. drives, says Gluck.

Holding the hype. The causes for failure are fundamental and apply to the entire industry, in the opinion of William J. Schroeder, president of Priam Corp., a San Jose drive manufacturer that recently merged with Vertex Corp., also of San Jose. "People get caught up in new things and the hype surrounding them, especially when engineers are running the companies," says Schroeder, an engineer himself.

"There is always tension between new technology and what already works. We're constantly erring on the side of the new," the Priam founder admits. His firm, which previously had played down its 8-in. lines to concentrate on the new 5¼-in. disk drives, has taken its lumps and reoriented its efforts.

Murphy of MegaVault has identified another error in marketing the smaller units. "Instead of one market for the drives, incorporated into a stand-alone computer, there is another segment: for shared memory. These are totally distinct, with no crossover," he explains.



Coming up. Sales of 5¼-in. drives storing from 100 to 300 megabytes of data could pick up as production hitches are resolved. More manufacturers may commit to the format once they achieve a reliable design for it.

As memory capacity gets larger, with the emphasis now on 100 to 200 megabytes, drives are shared by more than one computer—a fact that negates the size advantage of the 5¼-in. unit.

In addition, the 5¼-in. drives had been billed as having a price advantage over their big brothers, but now competition in that area is considered a virtual standoff. Fujitsu sells its 8-in. 168-megabyte drives in quantity for about $3,000, and comparable 5¼-in. units, which first were quoted at $2,000, are creeping up in price. Larger 8-in. drives, such as the MegaVault 330-megabyte, which goes for $3,200, are actually cheaper than their 5¼-in. counterparts—which are not yet even being delivered.

Reorientation. For suppliers of both sizes of drives, changes already are taking place. At Priam, for example, new 8-in. drives of 188 and 344 megabytes are in the works. Moreover, Schroeder says, "Our total manufacturing effort is focused on the 8-in. market now, with only the design engineering split between 8 in. and 5¼ in.," he explains.

Other firms are taking a different course, however. Micropolis Corp. of Chatsworth, Calif., is still putting most of its effort into 5¼-in. lines, even though it continues to sell 8-in. ones. "But as a practical matter, it's asking quite a bit to do both," notes Chet Baffa, Micropolis' marketing vice president. "Other firms are choosing, and we may have some tough decisions ahead, too," he says.

For the future, there is a surprising consensus from most players about the way the market will develop. The 8-in. drive will continue to do well in the 100- to 200-megabyte size for about two years, or until the 5¼-in. disk drives finally come through with proven products in volume. But by that time, the 8-in. drives will have carved out a solid market above that size, even to the extent of taking away much of the long-time domain of the established 14-in. drives.

Confirmation of this expectation comes from Control Data Corp., whose Peripherals Division is the dominant factor in large drives. Says Patrick McMahon, general manager of market requirements for the Minneapolis firm, "We could well have a new 8-in. drive ourselves in 1985."

Says Fujitsu's Gluck, "The proof of the demand is there, with six recent announcements of 8-in. drives [throughout the industry]. That's not a dying market, is it?"

SIEMENS READIES COMMERCIAL ISDN

Munich

In the communications world, the current buzz letters are ISDN, the integrated services digital network that transmits voice, text, data, and video over the same network and whisks the information from terminal to terminal over 64-kb/s channels. Mindful of what is to come later in the decade—nationwide, and even international ISDN networks—communication houses have installed trial ISDN systems, and semiconductor makers are designing the appropriate chips. Meanwhile, the International Telephone and Telegraph Consultative Committee (CCITT), has worked out recommendations and norms for the industry.

But for Siemens AG, ISDN has already become a commercial reality. The company's Communications and Information Systems Division in this Bavarian metropolis has readied a computerized ISDN private branch exchange (PBX) system for non-public applications in large organizations, offices, and similar facilities.

Debut. Dubbed Hicom, which derives from high-fidelity communications, the system will go into volume production during the first half of the year, with first deliveries toward year's end. Modularly constructed, it can be expanded from a small unit for 100 subscriber lines to a large configuration for more than 16,000 lines.

Because the ISDN transmission rate is 144 kb/s, two 64 kb/s channels can be used at the same time, allowing simultaneous multicommunication, says Walter Puls, sales director for private and special communications networks at the Munich division. The remaining 16 kb/s are for the signaling channel.

Therefore, a Hicom multiterminal, such as the one Siemens has designed, can perform all jobs that currently require a telephone, a text terminal, a data station, and a display screen—each with a different dial number and each using different protocols and interfaces.

Multicommunications should considerably enhance the exchange of information between offices, says Puls. For example, simultaneously with a phone call, the text on a display can be relayed to or received from other Hicom terminals as electronic mail.

In addition, while data is sent over one channel, video signals for nonmoving pictures can be simultaneously relayed over the other channel. With a Hicom multiterminal, of course, it is possible to edit, correct, and supplement text right at the terminal. Further, the terminal can access the system's computer to call up, for example, a list of names or numbers for communications. A display shows both the number and the name of the caller. What's more, with videotex, subscribers can call up and display text and graphics information from a data bank.

Hicom also accommodates telefax equipment. A newly developed class-3 Siemens unit reproduces the information on a standard-size page in 20 s. In addition, the system handles teletex communication service that transmits text between electronic typewriters or word processors at rates of 2,400 b/s [*Electronics,* April 7, 1981, p. 101].

Coming attraction. A technician works on the Hicom PBX system, which uses two channels for "multiple" communications, each with a different protocol.

The Hicom concept is based on Siemens' Bureau-Architecture. It defines product design, configuration, user interfaces, and protocols, taking into consideration the norms provided by the CCITT and the International Standards Organization (ISO). The SBA's aim is to minimize the product variety and takes into account the interfaces of all important equipment manufacturers to ensure compatibility.

Dedicated servers. In the Hicom system, adapters tie together the digital voice part with, for example, telefax and teletex stations. A switching unit connects subscribers to the lines, a process that is coordinated and monitored by administration and data servers. Other servers, such as voice-mail servers, are modules for storing and distributing speech.

Key components in the Hicom system are special very large-scale integrated telecom circuits that control pulse-code modulated (pcm) line switching. Of note is the Sicofi, which integrates a signal processor, a codec, and a filter on a chip [*ElectronicsWeek,* Aug. 20, 1984, p. 32].

It integrates some 36,000 transistors on a 40-mm^2 chip, a density, Siemens says, that so far has been unattained for telecom chips with analog and digital logic.

The peripheral board-controller circuit performs 22,000 transistor functions on a 38-mm^2 chip [*Electronics,* Jan. 13, 1983, p. 86]. This intelligent multiplexer/demultiplexer monitors the time-slot-oriented pcm channels and processes the data stream for control and signaling of the individual subscriber circuits. Operating at a rate of 4 Mb/s, it is able to accommodate up to 16 subscriber lines. **–John Gosch**

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William Thomson, Lord Kelvin
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JAPANESE HAVE YEN FOR U.S.

Los Angeles

The final barriers to the long-expected influx of venture capital from cash-loaded Japanese groups seem to have been breached, and a trickle of capital has started to flow into the U.S., albeit on a small and tentative scale.

Two major impediments have been holding back Japanese cash from U.S. shores, say industry experts. First is the lack of a clear-cut policy by the Japanese Ministry of Finance, which must approve each agreement. Second is the fact that prospective Japanese investment managers had not yet acquired the kind of expertise in U.S. venture-capital deals necessary to pull them off.

But apparently these problems have begun to be solved. Tokyo Venture Capital, a division of Diachi Kongyo Bank, Tokyo, Japan's largest bank, has announced that it has put money into a small peripherals manufacturer, Racet Computes Inc. in Orange, Calif., and is nearing completion of negotiations for financing a disk-media firm, Komag Inc. of Milpitas, Calif. Furthermore, Tokyo Venture Capital is publicizing an aggressive program of seeking this kind of investment on a larger scale, accepting the same risks as its U.S. counterparts.

Racet founder and chairman Ron Johnson had no intention of blazing a trail to foreign funding when he first went looking for outside capital in March 1984. Caught in the capital drought that followed the high-technology boom ending in late 1983, he was searching desperately for any kind of financing. "Anyone having to depend on the American capital markets, then and now, has to quiver in his boots," he says.

Admittedly, Johnson had a head start in the search. His firm already had connections in Japan through marketing software products there, and through contacts made by his wife, Arana Chiyoda Johnson, who cofounded Racet and is a native Japanese. Too, as is often the case in Japanese business, a trading company was instrumental in bringing together borrower and lender.

Playing the role of matchmaker was I. Ishibashi, general manager of special products research and development for the Machinery Division of Shinsho Corp., Osaka. After months of discussion, largely "building the whole web of relationships necessary to any business undertaking in Japan," in Johnson's words, the Ministry of Finance suddenly gave its approval in August.

Moving right along. "Things happened so fast then that we couldn't believe it," he recalls. He believes that the Japanese government wants such investments to increase rapidly—at the urging of U.S. government officials—and therefore speeded up the Racet loan in order to have a precedent in place.

Johnson terms the initial sum insignificant, but is closing negotiations for a sizable second round of financing. Moreover, he is actively helping Tokyo Venture Capital line up other potential loans.

The U.S. executive notes other advantages than financing, once Japanese contacts are established. For one, he might get Shinsho to manufacture Racet's PCMS-411 mass-storage system. The U.S. firm is already selling a copier for color video terminals manufactured by a Shinsho electronics manufacturing subsidiary, Shinko Electric. "It's a long-term relationship that works in both directions," Johnson notes.

Komag president Stephen Johnson (no relation to Racet's Ron Johnson) sees the Japanese venture capital move into the U.S. as an ideal match. "The Japanese are sitting there lusting after U.S. innovation, and things are tough raising capital here." He expects many more such deals soon and believes these will help make inroads into the "unfavorable balance of payments, in a way." Komag, which was founded in June 1983 to produce sputtered thin-film disk media, expected its financing arrangement would become final in late December.

The Japanese investments are "classic venture capital arrangements," says Shinsho's Ishibashi. Loans are expected to run between 18 months and two years. And, he emphasizes, there is no interest among Japanese financiers to pursue anything except "solid business deals"—marginal propositions will be turned down. –**Larry Waller**

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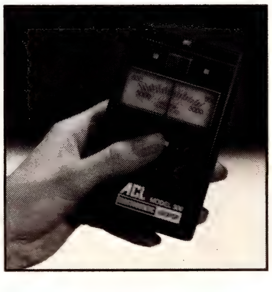

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NEW SYSTEM AIDS BLIND OPERATORS

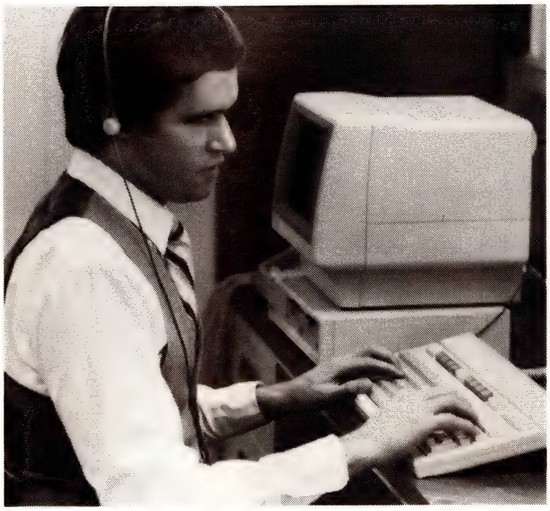
Los Angeles

Talking computers—microcomputer systems that use speech synthesizers—already offer a boost to the employment opportunities for blind or visually impaired persons. But experience has shown that existing hardware systems fall short of performing well enough to allow these highly motivated workers to compete more equally with the sighted.

This system-feature gap could be narrowed considerably, however, by a new computer dubbed Total Talk, a greatly modified Hewlett-Packard Co. model 150 microcomputer. Designed by Maryland Computer Services Inc., Forest Hill, Md., the desktop unit, through keyboard and control-software enhancements, translates a video data display into "a verbal-audio screen," says Daniel Gorney, manager of marketing and sales.

With the speech synthesizer, firmware, and new software added to the HP 150, the computer not only "speaks any information appearing on its screen, it lets the blind user create and manipulate this material," says Gorney. This is a unique capability unmatched by any other equipment, he claims.

Help from the blind. Total Talk was developed over a period of five years in a project aided by numerous blind computer engineers and programmers. It builds on the experience MCS has gained by specializing in supplying such equipment for the blind on a worldwide scale (see "Firm focuses on helping the visually impaired," below). Most directly, the computer has benefited from lessons learned from its predecessor, the Information through Speech unit, a much bulkier performer based on the HP 125 microcomputer.



Beneficial. The Total Talk system from MCS will make work easier for vision-impaired users, such as David Simpson, a blind programmer who helped develop the system.

According to Gorney, Total Talk is intended as a full-fledged microcomputer able to communicate with systems made by most firms. "It is not some obscure, second-rate machine for the handicapped," he says. The system's most notable difference is at the right side of the keyboard, where MCS has reprogrammed the HP 150's standard numeric pad into the speech-control module.

The big improvement comes from this speech pad, which lets a user keep his hands on the keyboard while controlling the computer's speech. Previously, controlling a machine's speech required adjusting dials and knobs located off the keyboard, MCS says, a task a blind person often could not perform alone.

By pressing the correct keypad numeral, a user can choose to review material one word, a line, or a screenful at a time. Moreover, the rate of speech can be changed from 45 to 720 words per minute with the key adjustments. Even such screen enhancements as underlining or boldface are announced.

Along with the cut in programming time possible with the speech pad, the computer has several programs for blind users, including a translator that prepares data for output to a Braille hard-copy peripheral. A talking data-base manager is provided, too, for keeping track of addresses, phone numbers, and dates. An MS-DOS operating system allows the system to run the most popular software programs.

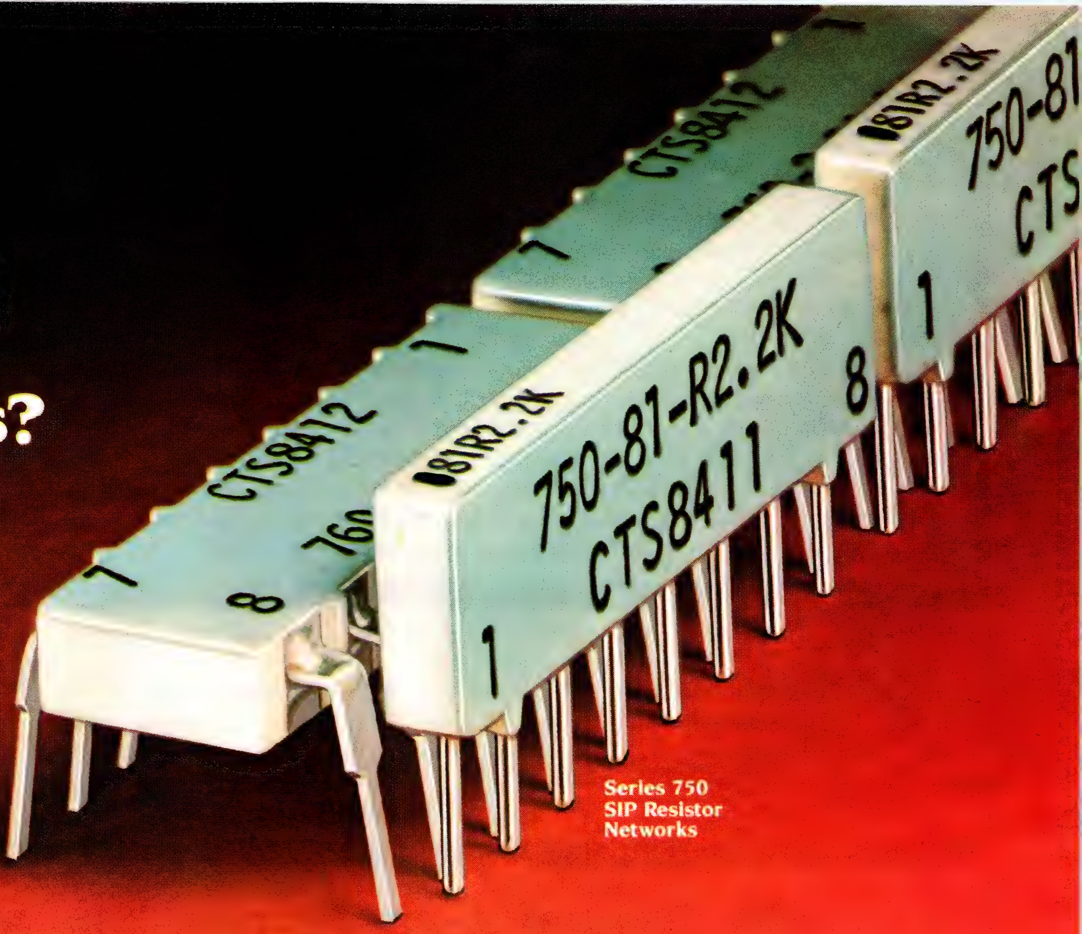
The computer sells for approximately $8,000 without Braille-oriented peripherals. A fully configured system costs $11,000, and training costs vary: In the field, it can run $1,000 plus expenses for the teacher; at the Maryland headquarters, half that figure. MCS officials expect to

Firm focuses on helping the visually impaired

Founded in 1976 by two former civilian engineers for the U.S. Army, Maryland Computer Services Inc. first concentrated on developing custom business applications for computers made by Hewlett-Packard Co. of Palo Alto. A year later, company president Deane Blazie and vice president Richard Kramer narrowed the firm's focus to adding products for the blind and visually impaired. The company came up with the microprocessor-based Talking Telephone Directory. In the seven years since, MCS has continued to bring out new products, largely financing its own research and development. More than 525 of the firm's talking terminals and computers have been sold.

The market has more scope than is apparent at first glance, the company notes. There are about 11.4 million persons in the U.S. with some kind of visual problem, of which 1.4 million are legally blind. MCS is growing at a 40% annual compounded rate, it says, with 1984 sales of about $3 million. These are forecasted to nearly double in 1985.

Why inspect incoming resistor networks?



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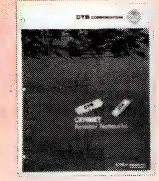

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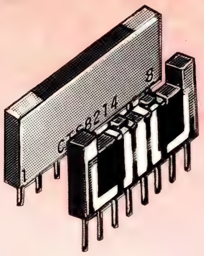

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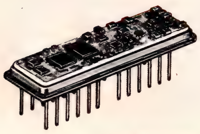

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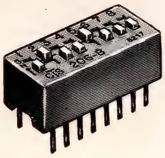

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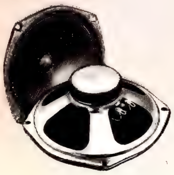

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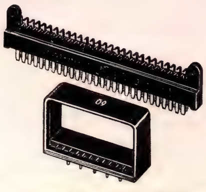

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Japanese develop word processor for the blind

The last barrier to knowledge work in Japanese by the blind has fallen with the development of Versa Braille—word-processing software that enables sightless persons to transcribe tape-recorded prose, write original text, or write computer programs.

The program was developed for NEC Corp.'s popular PC-9801 personal computer by NEC distributor Y.D.K. Co. and the Vocational Development Center for the Blind in Japan Inc., both in Tokyo. Like word processors for the sighted, it uses standard Japanese syllabary characters on the computer keyboard for phonetic input of text, which is converted to the combination of Kanji Chinese and Japanese characters used in written Japanese. The typist is required to add a syllabary-character tag to indicate the pronunciation of each Kanji Chinese character—a method developed for writing Japanese in Braille—for character selection. Other word processors rely on lexical, syntactic, and sometimes even the semantic content of the text for character selection and require the typist to check a video display for the occasional misconverted character. A complete system—including a speech synthesizer that echoes keystroke input, disks, printer, cathode-ray-tube display, and tape recorder—will sell for about $6,000, which Y.D.K. figures is affordable for firms employing the blind. –**Charles L. Cohen**

sell 400 Total Talks in the next year in the U.S. and perhaps 100 more worldwide (for a related effort in Japan, see "Japanese develop word processor for the blind," above).

MCS officials last month completed a seven-city U.S. tour, showing Total Talk to such prospective buyers as the Braille Institute, located here. Reaction to the new computer, officials say, has been excellent, with a general agreement that it greatly extends the degree of blind operator use and reduces the need for help from sighted workers. –**Larry Waller**

DISPLAYS

EL DISPLAYS GLIMMER AGAIN

Poole, England

After a 15-year developmental and commercial roller-coaster ride, electroluminescent displays may soon be flashing a brighter future for tiny Phosphor Products Co. Ltd., located on England's south coast in Dorset. Solving some of the problems in the technology has spawned the beginnings of user acceptance, with PPL signing its first license agreement with a U.S. firm.

Several factors are helping to change the prospects for this attractive display technology, according to Peter Smith, PPL's managing director. The first company to score with its ac electroluminescent flat panel was Japan's Sharp Corp., which used it in the Compass portable computer by Grid Systems Corp., Mountain View, Calif. Its success has gone a long way to promote the technology in the U.S., says Smith.

Display manufacturers are also playing their part to help the market by collaborating on display standards. This may mean that manufacturers' displays will soon be interchangeable, even though the technologies may be different. Sharp, for example, uses ac electroluminescence, while PPL uses dc.

Technology advances. The technology is also maturing. Originally, it lacked suitable high-voltage driver integrated circuits, but standard parts—Texas Instruments Inc.'s 7555 series, for example—can now drive dc and ac electroluminescent or plasma panels. Even with the 7555, however, 26 chips are still needed to drive PPL's half-screen display.

Flat panel is a soft touch

Touch switches have been integrated into electroluminescent flat panels in the UK by Phosphor Products Ltd., Poole, and Tube Investments Research Laboratories, Saffron Walden, Essex. The technique uses the display's own scan circuitry and needs only one extra electrode, a touch plate formed on the front of the glass-faced display.

Low-cost, fixed-legend panels suitable for mass production were first developed for use in washing machines, microwave ovens, and stoves. One version has a 16-key touch panel. Researchers have integrated touch switches with dot-matrix displays to give four programmable (or soft) keys where the message, or legend under the switch, can be altered under program control.

For this, an added indium-tin-oxide layer is formed on the display's front surface. The translucent conductive coating serves as the touch pad, capacitively coupled to a split-cathode electrode formed on the reverse side of the glass panel. In operation, a sensing pulse is applied to the inner electrode instead of the usual display-driver pulse. Since the cathodes are disconnected, the display does not change. When the panel is touched, body capacitance drains off some charge and this can be detected by a simple circuit.

In a dot-matrix display, the panel is driven in standard multiplexed fashion. As a touch switch, all the anodes are pulsed simultaneously and the whole arrangment becomes a standard touch switch, with the sense-plate output of each element leading off the bottom of the panel. The switches are interrogated three times in this way under microprocessor control. Control is then returned to the display. –**K.S.**

Display reliability, once a problem, is now excellent. Also, these displays can be produced repeatably, says Smith, who has raised a $1.78 million stake to set up the first small-volume production line. Until now, displays for British Telecom and others have been made in small batches.

According to Smith, dc electroluminescence is a potentially cheaper technology than the ac alternative, because it is based on a simple thick-film powder process and does not use an expensive vacuum-forming process as do ac panels. Manufacture begins with a glass faceplate covered with a translucent coating of indium tin oxide acting as the display electrode and is photolithographically etched to form an electrode pattern.

Next, a manganese-doped zinc sulphide powder phosphor is sprayed onto the front plate, and then a rear electrode of aluminum is evaporated onto the phosphor layer. Bridge contacts are silkscreened along the edges of the phosphor-aluminum layer to make contact between the contact pads on the substrate and the aluminum rear electrodes. The row electrodes are generated by mechanically scribing the layer. Using this technique, the active pixel area is 0.010 in. by 0.010 in. on a pitch of 0.0125 in. in both directions. Finally, a hermetic encapsulating dome is added.

Using this technology, Phosphor Products has now come up with a prototype half-page display with a matrix of 560 columns by 250 rows and a resolution of 80 lines/in. in both directions. Mounted with its driver circuitry, it forms a subsystem flat screen that can be refreshed at a frame rate of 60 Hz and consumes around 10 W (see "Flat panel is a soft touch," p. 38).

LCD competition. Of course, dc electroluminescent displays will be competing against upcoming flat-screen liquid-crystal displays with matrix addressing, but, says Smith, there is a place for both active and passive displays.

The first payoff for PPL has come with the recent signing of Chicago's Cherry Electrical Products, its first U.S. technology licensee. Cherry will scale-up the UK company's thick-film powder phosphor technology before launching a 2,000-character flat-panel display sometime within the next one to two years.–**Kevin Smith**

MATERIALS

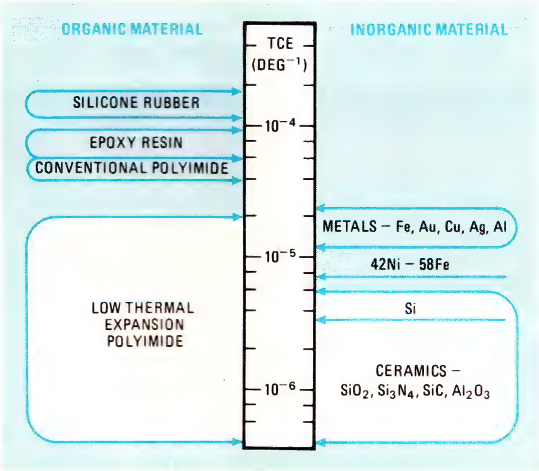
POLYIMIDE'S TCE MATCHES SILICON'S

Tokyo

Polyimide can stand up to high temperatures, and that characteristic has won it a variety of applications in electronics fabrication. It is often used as the base material for printed-circuit-board laminates, for example. And it turns up frequently as a substrate for flexible circuitry. Another common use is as a general-purpose insulator for equipment that has to stand up to harsh or extreme environments.

In their purest form, polyimide materials are currently being evaluated for two critical steps in the fabrication of integrated circuits. They are under consideration as a protective layer atop dynamic random-access memories in order to protect them from the alpha particles that can cause soft errors. And they are being studied as thin insulating films for multilevel very large-scale integration chips.

Comes with a drawback. As so often happens, however, along with the advantages comes a drawback. In currently available polyimides, there is a large differential in their thermal coefficient of expansion and that of silicon chips and the materials used to passivate them, such as silicon dioxide or silicon nitride. The mechanical stresses thus caused can actually crack the top surface of a memory chip at high temperatures.



Well matched. Thermal coefficient of expansion for Hitachi's polyimides blankets that for silicon and common packaging materials, easing stress on ICs.

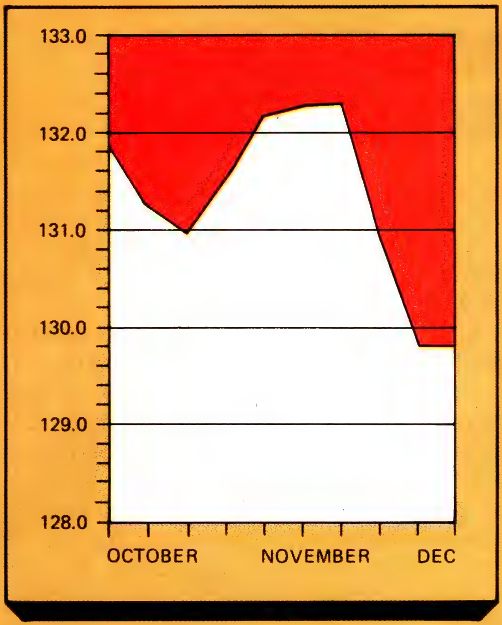
To keep chips from cracking, Hitachi Ltd.'s research laboratory has developed a new family of polyimides with a low thermal coefficient of expansion (TCE). At a technology seminar in New York last month, Osamu Asai, deputy general manager of the lab, explained that the company had found that some polyimides have very low coefficients of expansion and had exploited that discovery by using molecular design techniques to develop the new materials. These will become available late in the year. As the drawing shows, the new polyimides span a TCE range from 4×10^{-6}/K (comparable to quartz) to 2×10^{-5}/K (comparable to aluminum).

Silicon, silicon nitride, and silicon dioxide, all used extensively in IC processing, fall within the TCE ranges of the new Hitachi polyimides. This means the new polymerics can serve as stress-free coatings either for alpha-particle protection or for multilayering.

Along with exemplary TCE, the improved polymers have several other noteworthy qualities. Strength and modulus are three to six times as large as they are in conventional polymers. The new polyimides also have a thermal decomposition temperature and softening temperature of 500°C or more; this is some 50°C higher than for conventional polyimides.

Other possible uses of the new polymers include binders and substrates for magnetic disks, aligning layers for liquid-crystal displays, and protective layers for solar cells.– **Jerry Lyman**

ElectronicsWeek Index



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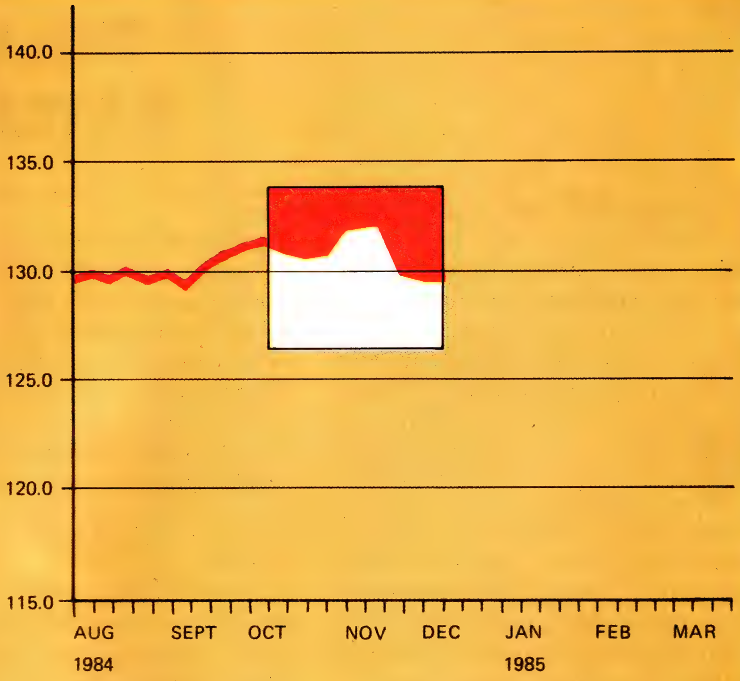
YEAR AGO = 107.9
1982 = 100.0



The *ElectronicsWeek* Index, a seasonally adjusted measure of the U.S. electronics industry's health, is a weighted average of various indicators. Different indicators will appear from week to week.

U.S. ELECTRONICS EMPLOYMENT

Production workers (thousands)	October 1984	September 1984	October 1983
Office and computing machines	200.1	202.5	197.6
Communications equipment	291.9	288.1	264.6
Radio and TV receiving equipment	64.4	64.9	62.5
Components	425.5	426.2	368.2

U.S. GENERAL ECONOMIC INDICATORS

	October 1984	September 1984	October 1983
Average prime rate (%)	12.58	12.97	11.00
Retail sales ($ billions)	107.7	107.9	100.9
Unemployment rate (%)	7.3	7.3	8.7

Total employment in the U.S. electronics industry remained steady in October, the latest reporting period, and helped keep the *ElectronicsWeek* Index at last week's level. Although total employment in the industry held firm, there were some noticeable shifts within individual electronics sectors. For example, office and computer equipment makers and components companies reduced their workforce by 1.2%, while communications equipment makers increased their employment rolls.

In other economic areas, whose data are also used to compile the Index, interest rates dropped slightly, but retail sales and general unemployment rates stayed essentially flat. With interest rates continuing to slide and electronics exports expected to outpace imports, the next move in the Index is likely to be up.

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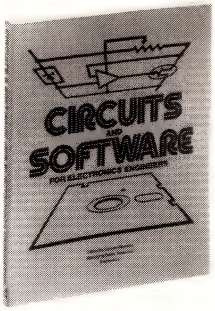

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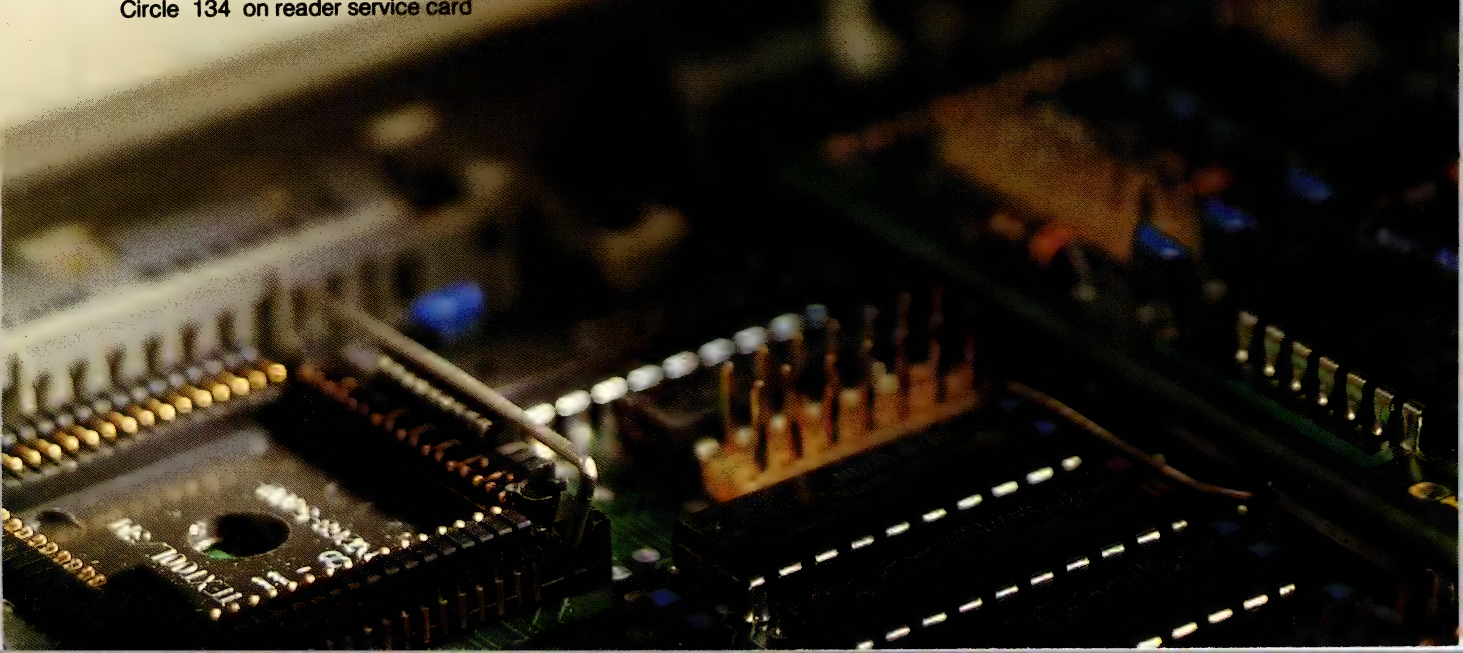

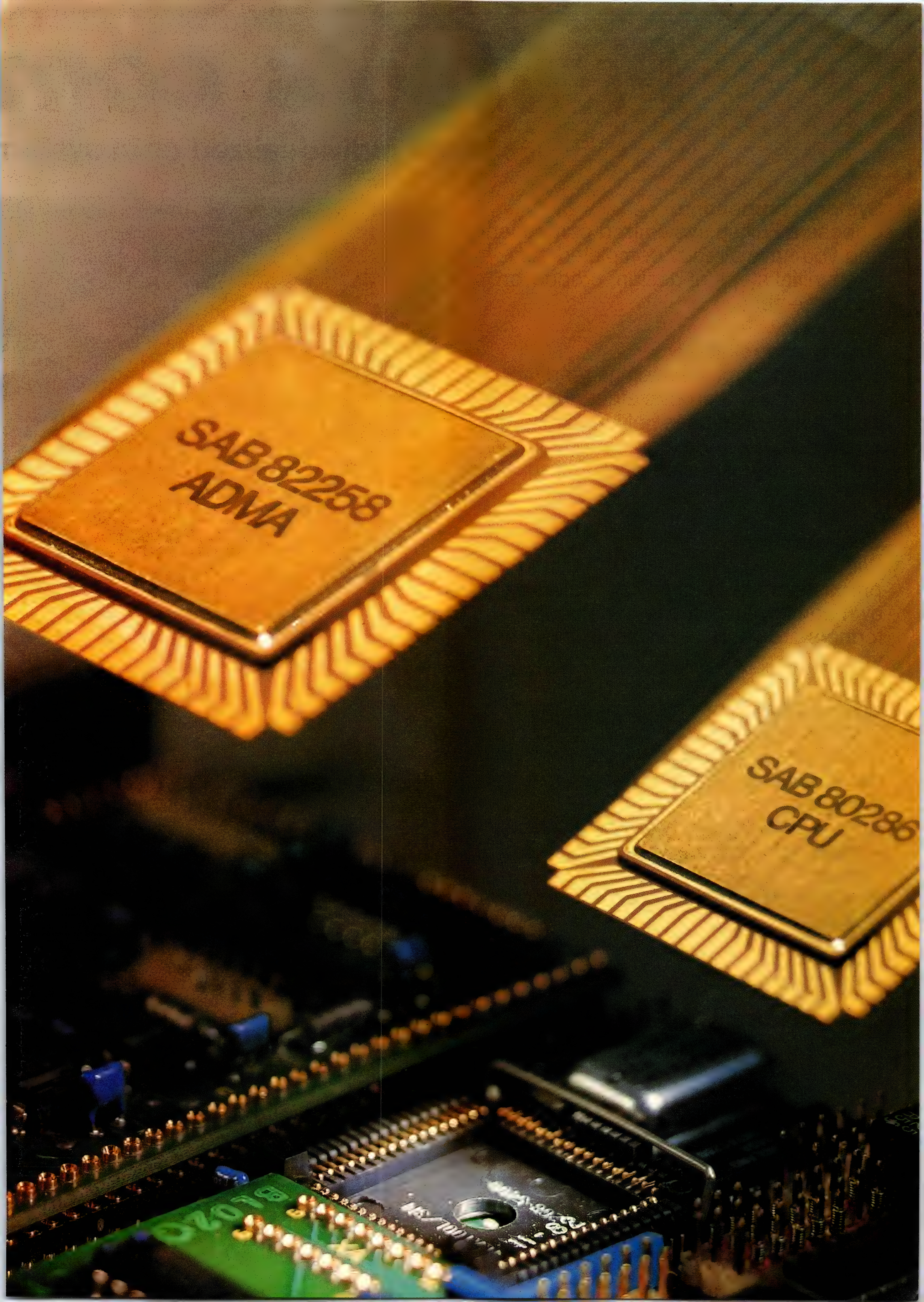
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NEW HEAD OF MITSUBISHI AMERICA RESISTS THE PANIC BUTTON

Torrance, Calif.

Those U.S. executives so caught up in dealing with problems of the moment—particularly in today's less-than-robust marketplace—would do well to cultivate the unflappable outlook and longer perspective of Takeshi Sakurai. A well-traveled, 23-year veteran of the top management ranks at Tokyo's Mitsubishi Electric Co., he took over as president of its U.S. subsidiary, Mitsubishi Electronics America Inc., this summer.

But as it turns out, the timing of his move was less than ideal, given the general weakening in the market for small computers, peripherals, and semiconductors, Mitsubishi's main products. Unlike many of his U.S. counterparts though, Sakurai, 47, refuses to hit the panic button.

Just part of a cycle. He sees the market's condition as just a phase in an inevitable cycle. "It's softening, that's right. But this happens," he says with his characteristic calm. The executive adds that he is "rather optimistic," even about prospects for semiconductors, despite the gloom-and-doom scenarios now circulating in the industry.

He thinks that whatever occurs in 1985 probably will be better than the wipeout of 1982. Demand, for example, should continue to grow, with trouble coming instead from increases in manufacturing capacity.

That area may be especially troublesome to Mitsubishi, which has plans to bring a new fabrication plant on line this month. Located in Raleigh, N.C., the new facility will be at the center of the ensuing tussle for market share. First turning out 64-K dynamic random-access memories, then adding 256-K memory and gate arrays, Mitsubishi is earmarking 100% of the plant's production for the U.S. market.

Sakurai, who most recently served as manager of export sales and marketing for semiconductors at Mitsubishi corporate headquarters, in fact, believes that the market oversupply of integrated circuits soon will straighten out. "The industry needs more capacity," he says.

As for other lines sold by Mitsubishi, notably disk drives, computers, and printers, market developments have taken place even more rapidly than he anticipated. "I'm more concerned about these products, because the competition has increased so quickly," he says.

"Rather optimistic." Mitsubishi's new man in the U.S., Takeshi Sakurai, foresees a bright future for semiconductors, despite the current market softening.

Mitsubishi America, which in 1984 had about $350 million in revenues, does not plan to back off, however, because the U.S. market is so central to its worldwide planning. "We count on steady economic growth here, and recognize that many countries are tied to the U.S. market," he explains.

Sakurai and his family settled quickly into the Southern California lifestyle. Years of living outside Japan has given them "preparedness for these changes," he says, pointing to a record that includes serving as senior representative in London, director of Ascenseur Mitsubishi de France, and president of Mitsubishi Electric Netherlands B.V.

In addition, many Japanese firms have their U.S. headquarters located in the South Bay section of Los Angeles, where Mitsubishi America is located. The area has one of the largest contingents of U.S.-born Japanese in the country, so its supporting services "make it easy to settle in for a Japanese," he notes. **–Larry Waller**

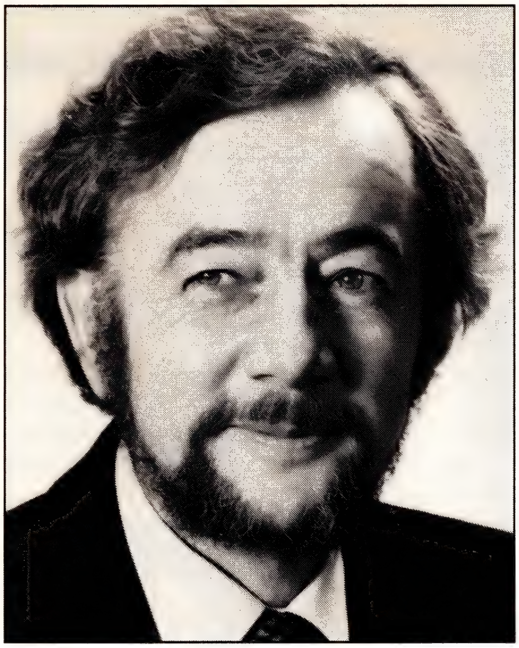
CCITT director wants decentralization

Darmstadt, West Germany

His colleagues call him "der fliegende Theo"—German for "the flying Theo." This alludes to Theodor Irmer's frequent travels in his roles as project coordinator for digital switching and transmission at the Engineering Center of West Germany's Ministry of Posts and Telecommunications, based here, as well as adviser to that ministry in bilateral negotiations on communications held abroad and chairman of a study group of the International Telephone and Telegraph Consultative Committee (CCITT).

But as the new director of the CCITT, Irmer, if he can help it, wants to be less peripatetic after he moves to Geneva to assume his post later this month. A wish, he feels, that will probably go unfulfilled. "More travel may well be the case," he says with a sigh.

Briefly, the CCITT, an organization of the International Telecom-



Leveler. Theodor Irmer believes the CCITT will work more efficiently in establishing standards by forming smaller working groups.

munications Union (ITU, which in turn is a body of the United Nations) recommends technical standards for all types of networks and services ranging from telephones and telegraph, to telex, videotex, data communications and telefax services, and, lately, the Integrated Services Digital Network.

The CCITT's recommendations are submitted for adoption to the world's postal administrations, operating companies, and communications firms. All of the 150-odd countries in the UN are invited to take part in the process, although many are too small to send delegations.

"With new technologies spreading fast and with more and more semiconductor houses getting involved in telecom circuits, the process of arriving at—ideally—worldwide standards is increasingly becoming a complex one for the CCITT to handle," Irmer says. As a remedy, he wants to decentralize the organization by forming smaller working groups that can tackle tasks "more efficiently than can a larger body."

To Irmer, the first German to be elected to a leading post in the ITU's 120-year history (most of his predecessors were French), communications is a major part of his life. Born in 1932, he received his master's degree in communications engineering in 1962 from the Technical University of Karlsruhe, West Germany. After a few years' work in the industry, mainly in transmission-system development, Irmer joined the Darmstadt center, where he held a number of technical management positions.

Besides streamlining the CCITT's work, Irmer wants to help underdeveloped nations gain a greater say in the establishment of standards. To do this, he intends to urge the organization to hold more working group meetings at cities located in Africa and Asia, "so that poorer countries can send delegations at less expense than what would be involved if they had to travel to Europe or the U.S."

Irmer was elected CCITT director in October 1984 at the organization's Eighth Plenary Assembly in Torremolinos, Spain. Officials in Germany's communications industry who have worked with him say that it was not only the experience he has gained and the active role he has played while working within CCITT that swung the vote in his favor.

"His ability to bring together people with opposing opinions without anyone losing face and to get them to agree on workable and sensible compromises, had much to do with Irmer being named head of the organization," comments one industry executive. That ability may be in demand more than ever in future CCITT negotiations. **–John Gosch**

Safiol sees huge potential for product volume

New York

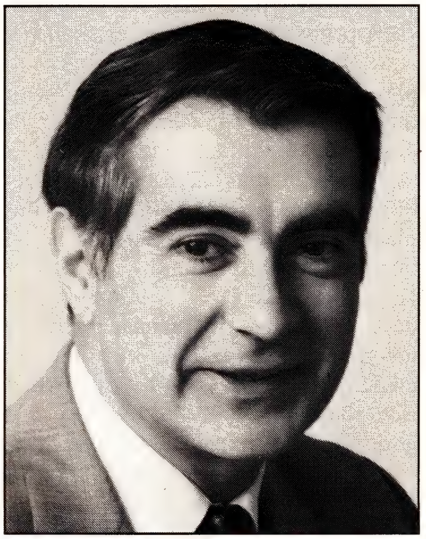
The biggest change in the electronics industry that George E. Safiol sees since he left it in 1977 is the potential for huge growth in the volume of products and revenues.

Safiol views the market from the perspective of his six-year stint as president and chief executive officer at American Biltrite Inc., a manufacturer of industrial rubber and plastic products that has its headquarters in Wellesley Hills, Mass. Safiol has rejoined the General Instrument Corp. here as senior vice president.

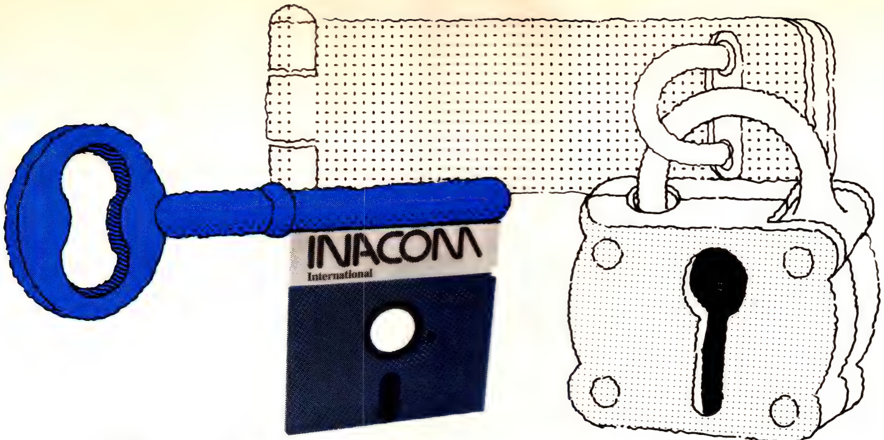
Safiol worked for General Instrument from 1971 to 1977, and his last assignment was as senior vice president in charge of cable television and consumer electronics operations—two markets that have recently confounded GI. (The company recently announced that net income in the second half of the 1985 fiscal year will be below the $20.8 million earned in the first half.)

Instead of returning to the cable operation, Safiol will have responsibility for operating three fourths of GI's Component Products subsidiary with divisions in Chicago (Clare and Lamp divisions) and El Paso, (Computer Products) as well as its Optoelectronics Division in Palo Alto.

A native New Yorker, the 52-year-old Safiol is a 1954 graduate of New York University's College of Engineering, with a BA in civil engineering. He assumed his new responsibilities in mid-November and reports to GI's president and chief operating officer, C. Morris Chang, [*ElectronicsWeek*, Sept. 3, 1984, p. 53] who took over last February. Safiol, who is paying his initial visits to his far-flung divisions, sees promise in products that cover the relay and networking sectors. **–George Leopold**



Returnee. Six years has made a big change in the potential for electronics product sales, says George E. Safiol of General Instrument.



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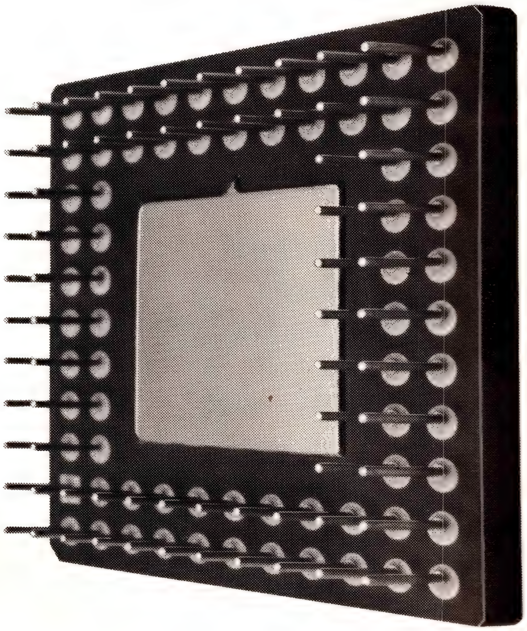

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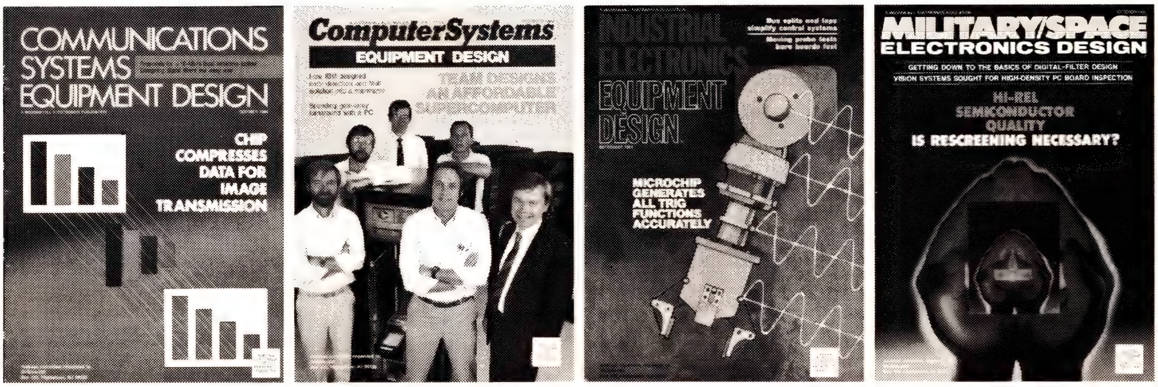
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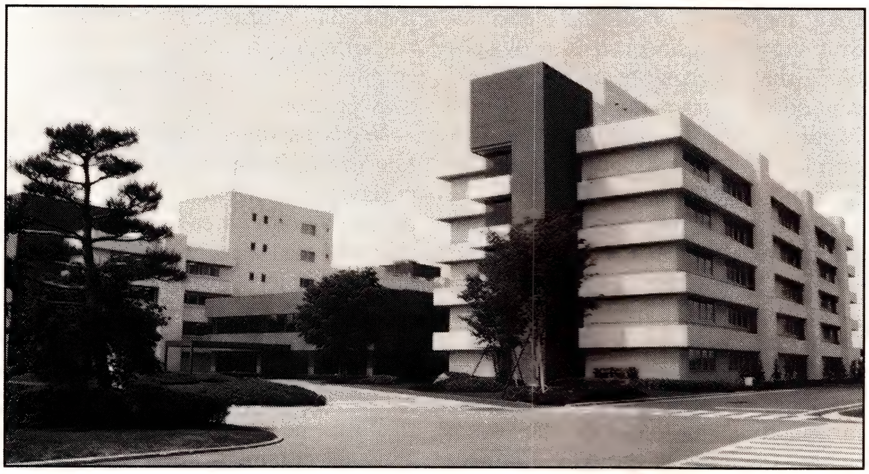
JAPANESE CHEMICAL FIRM MOVES FROM SOAP TO FLOPPIES



Industrious. Researchers at Kao Corp'.s laboratory near Utsunomiya developed the coated media for 3½-in. floppy disks that the company will sell to OEMs.

Tokyo

It might seem like a big leap from soap to electronics, but one Japanese chemical firm is counting on its expertise in the area of surface science for a smooth entry into the high-tech—and potentially risky—field of computer storage media.

Kao Corp., a $1.5 billion firm with most of its business in detergents, toiletries, and industrial chemicals, will start making 3½-in. magnetic disks next spring at a new plant and Technology Development Center it is building near Utsunomiya, about 100 miles north of Tokyo. The first product is a 1-megabyte unformatted medium, says managing director Hiromi Nakagawa, who heads the Research and Development Division, but Kao is also developing media with a capacity of 1.6 megabytes unformatted and small video disks for electronic still cameras [*ElectronicsWeek,* Nov. 26, 1984, p. 34].

All Japanese chemical firms want to enter industries with high growth rates, notes Naohiko Araki, a researcher at the Nomura Research Institute in Kamakura, because chemicals have little growth left. Chemical firms seek new business opportunities based on their technological expertise, agrees Sumio Arai, director of the new Business Development Department at Kao's Chemical Division. From its soap and detergents business, Kao has developed expertise in surface-activation chemistry and physics, and overall surface science, he says.

Thus, coating flexible polyester disks with magnetic particles is a natural for Kao. Nakagawa says the firm is counting on the new 3½-in. disk, and its expected rapid growth, for the firm's chance to enter the disk industry because the market for larger-size disks is more mature and more competitive, especially in price. Arai believes the 1-megabyte 3½-in.-disk market will be more quality- than price-conscious.

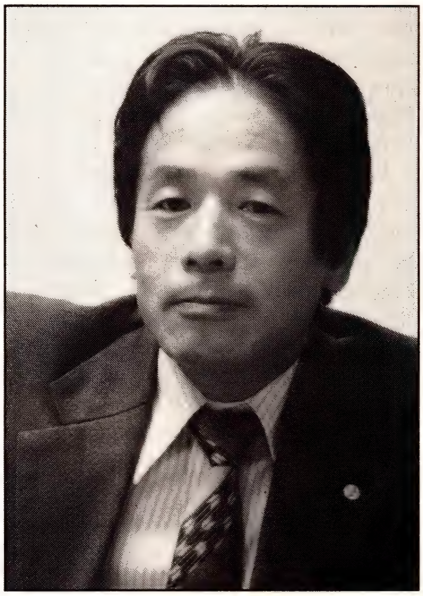
Kao will buy the polyester films to coat and then sell them to an original-equipment manufacturer, who will package them for sale. Initial production will be about 1 million disks a month.

Trump card. Kao is also working on storage media and perpendicular recording, Arai says. The firm believes its trump card for vertical recording is a new material it has developed: an amorphous, glass-like form of carbon that is an ideal substrate for thin-film heads. The surface is smooth and without holes, for uniform coating. Specific gravity is a low 1.45, keeping moving weight low for high positioning speed.

Moreover, the surface is very slippery—the material is a form of solid lubricant—so it can slide easily over storage media without damage and without a lubricant that can migrate and cause problems. The new material, called Glahard, can also be used as the slider in more conventional magnetic heads. Both Nakagawa and Arai say that Kao's long-range plans extend beyond coated media and thin film heads, but they decline to be more specific now.

Nomura's Araki believes Kao's expertise in surface science is directly applicable to magnetic media. He adds that Mitsubishi Chemical Industries Corp. of Tokyo has a joint venture with Verbatim Corp. of Sunnyvale, Calif., to make computer media in Japan, while photographic film vendor Fuji Photo Film Co. of Tokyo makes a complete line of tape and disks.

Kao's main liabilities in the stor-



Ambitious. Kao's plans go beyond coated media and thin-film heads, says Sumio Arai, director of the new Business Development Department at Kao's Chemical Division.

age-media market are lack of brand image and distribution, Araki says, but these shouldn't matter for OEM customers. The analyst says the scale of operation Kao envisions is the minimum size for a division and he thinks it will succeed, but he questions whether it can succeed in a big way in such a competitive arena.

Still, the venture will allow Kao to get its foot in the door of the electronics industry. In time, he says, Kao may perform better in making read/write heads, which are made by few manufacturers, unlike the drives.

Japanese disk suppliers aren't exactly losing sleep over the prospect of competition from Kao. Yasuo Kajiura, manager of the Second Marketing Department of Hitachi Maxell Ltd., Japan's top floppy-disk maker, says Kao's sales goal may be too small to keep it viable in the market.

Many players. In addition, competition is heating up, he notes, citing the rescue of Dysan Corp. of Santa Clara, Calif. by Xidex Corp. of Sunnyvale. Moreover, 3M Co. of St. Paul, Minn., is striking out with renewed vigor and giants such as Eastman Kodak and Polaroid have entered the fray. Kao is a big firm in toiletries, but Kajiura questions whether it can compete successfully in the data-processing field.

On the other hand, Maxell's Kajiura sees strong future growth for 3½-in. disks, which have been adopted by U.S. firms such as Hewlett-Packard, Data General, and Apple. But the disks lack high-volume users in Japan. Last year, almost nobody was shipping them, but this year Kao will be competing with a fair number of 3½-in.-disk vendors including Sony, Maxell, Fuji Film, TDK, Memorex, Verbatim, 3M, Nashua, and Xidex, he adds.

Kajiura says it might take four or five years for perpendicular recording to build significant volume. Still, he predicts explosive demand for higher-capacity file-storage media with higher access speeds as the microcomputer business shifts from 8- to 16- to 32-bit microprocessors. Inexpensive floppy replacements for hard disks would be ideal if they could be developed. Floppy disks with servo drives for extremely high densities and removable cartridge hard disks are two possibilities that he sees. **–Charles L. Cohen**

Italian firm seeks allies to crack U.S. market

Milan, Italy

Someone examining the work stations, personal computers, special-feature telephones, facsimile machines, and private branch exchanges that make up Italtel Telematica SpA's product line might well conclude that the equipment, though exceptionally attractive, is by itself unlikely to give the firm an edge in a business that has become known for its almost cutthroat competition.

But director of marketing Mario Becchi reckons such a view is dead wrong. "Our role is to supply the ideal node for the office, to integrate the telephone with added intelligence so that our customers can better use the telephone. That kind of expertise is very much in demand," he says.

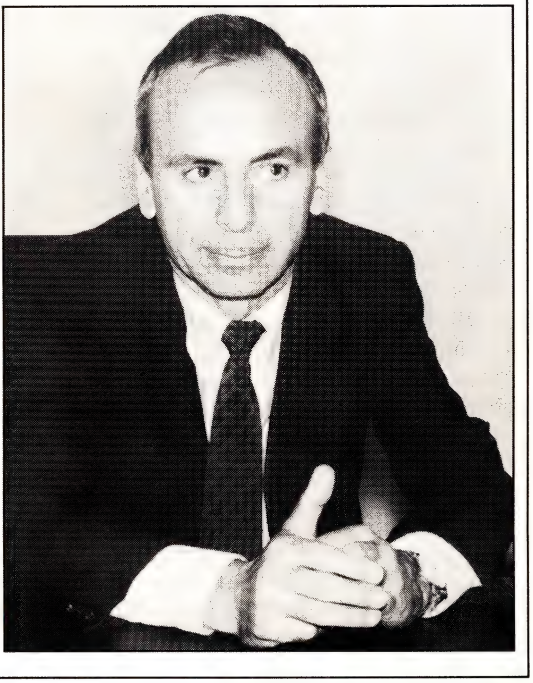
"If you look at the way alliances are being formed between data-processing companies and telecom companies, you'll see what I mean," he goes on. "Even a giant the size of IBM had no choice but to buy Rolm to have the telecom technology and know-how that it needs. But if a telecom company needs data-processing technology, that is simply no problem. That kind of technology is available and on the market. In our case, we just decided what we needed and went shopping for it. But who is left to provide a telecom offering for data-processing companies?"

The firm, wholly owned by Milan's Italtel Società Italiana Telecomunicazioni SpA, Italy's largest producer of public telecommunications switching equipment, was set up two years ago by Marisa Bellisario shortly after she took over as head of Italtel. The firm then was drowning in red ink, and two of Bellisario's strategies for rescuing the firm were to broaden its competitive base (then largely restricted to the Italian market) to the international arena and to expand its offerings in the private-communications sector.

The latter job is the *raison d'être* of Italtel Telematica, and the fledgling company's performance supports Becchi's contention about the availability of equipment. A corporate shopping spree netted, among other things, a snazzy modular office work station from Sydis Inc. of San Jose, Calif., and a printed-circuit board for an IBM Corp.-compatible personal computer that Italtel turned into its own product.

Needs partners. But the real question facing the firm is whether it can parlay its telecom expertise and products into a coherent offering that will find a niche in the complex market created by the convergence of data processing and telecommunications. "I'd give them at least a 50-50 chance of making some kind of impact, but they can't do it alone," says the European sales manager of a U.S. telecommunications equipment firm. "Everything depends on the kind of partners they're able to find."

Becchi agrees. "We already have a 50% installed base in the Italian market, and the only other real market is in the U.S., so what we've got to think about is who is going to distribute our product line." But he believes the market's buying power is in Italtel Telematica's favor. "In the U.S., if you're a DEC or an Apple, you've got to be looking for a telecom partner." **–Robert T. Gallagher**



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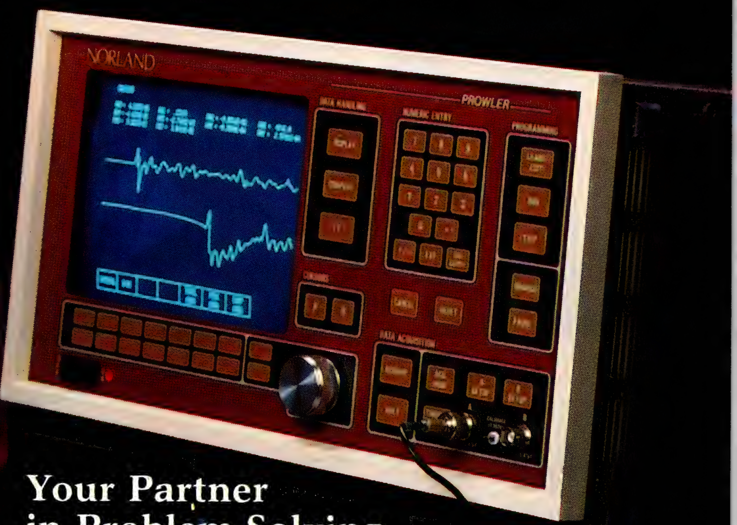

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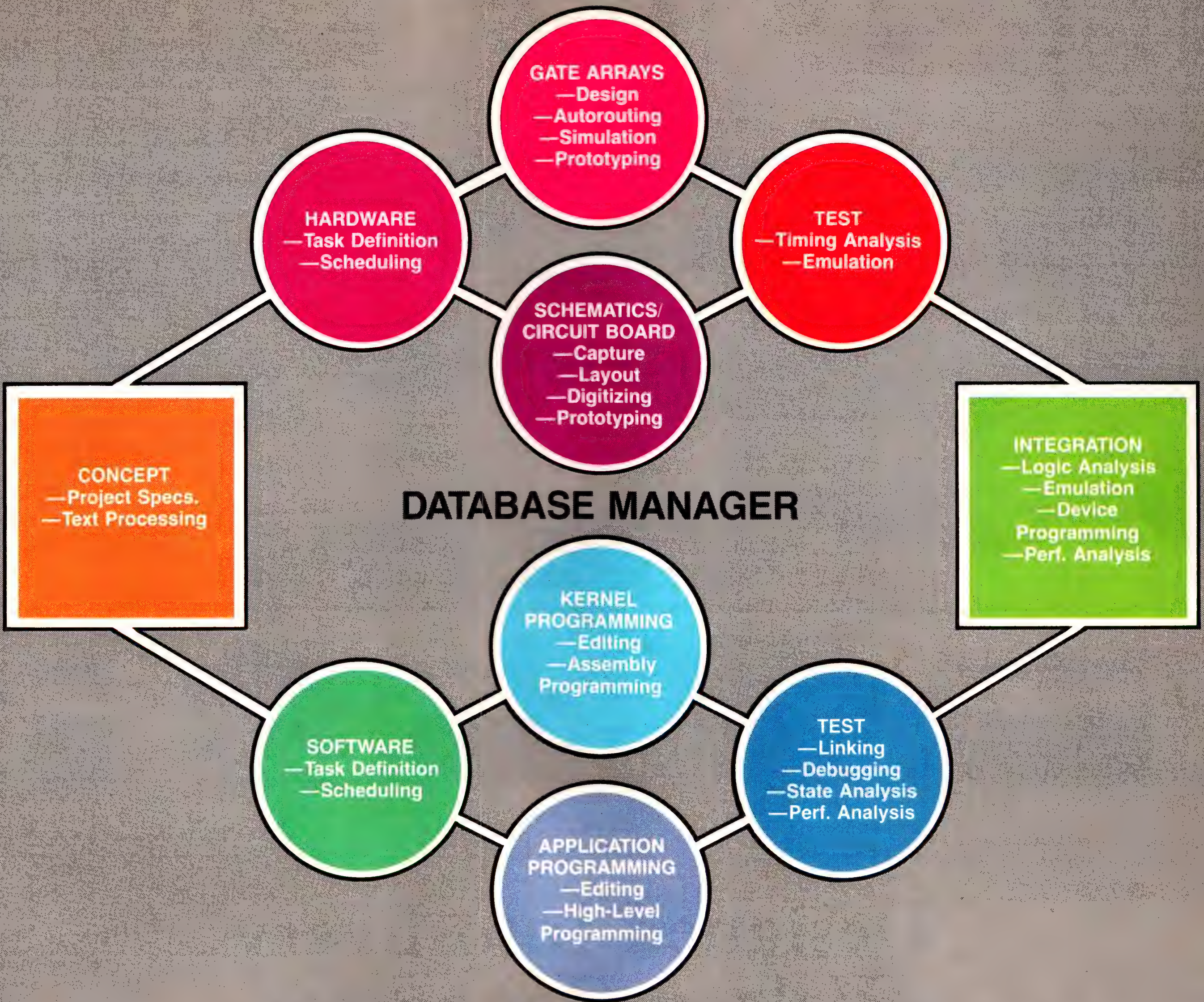

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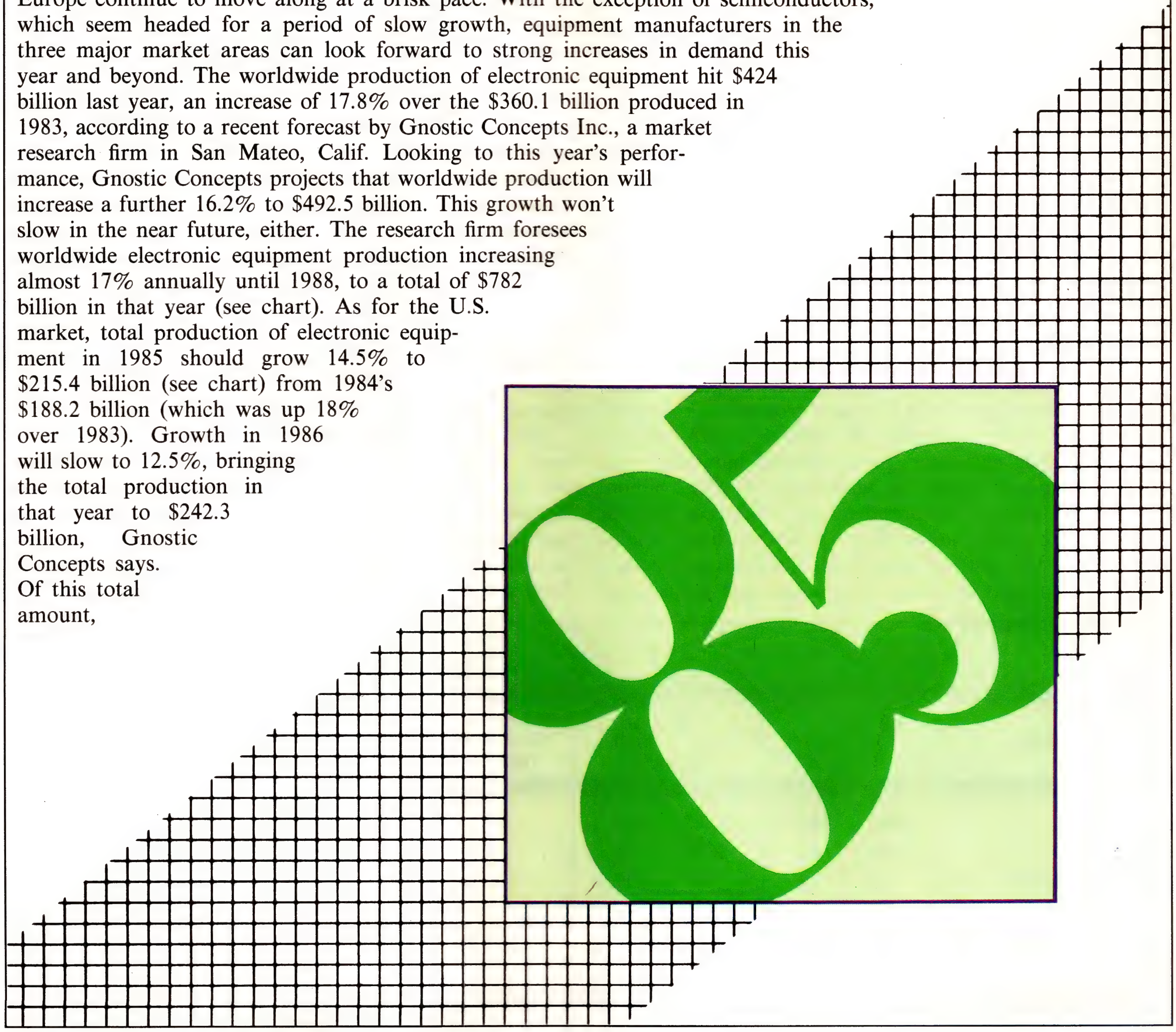
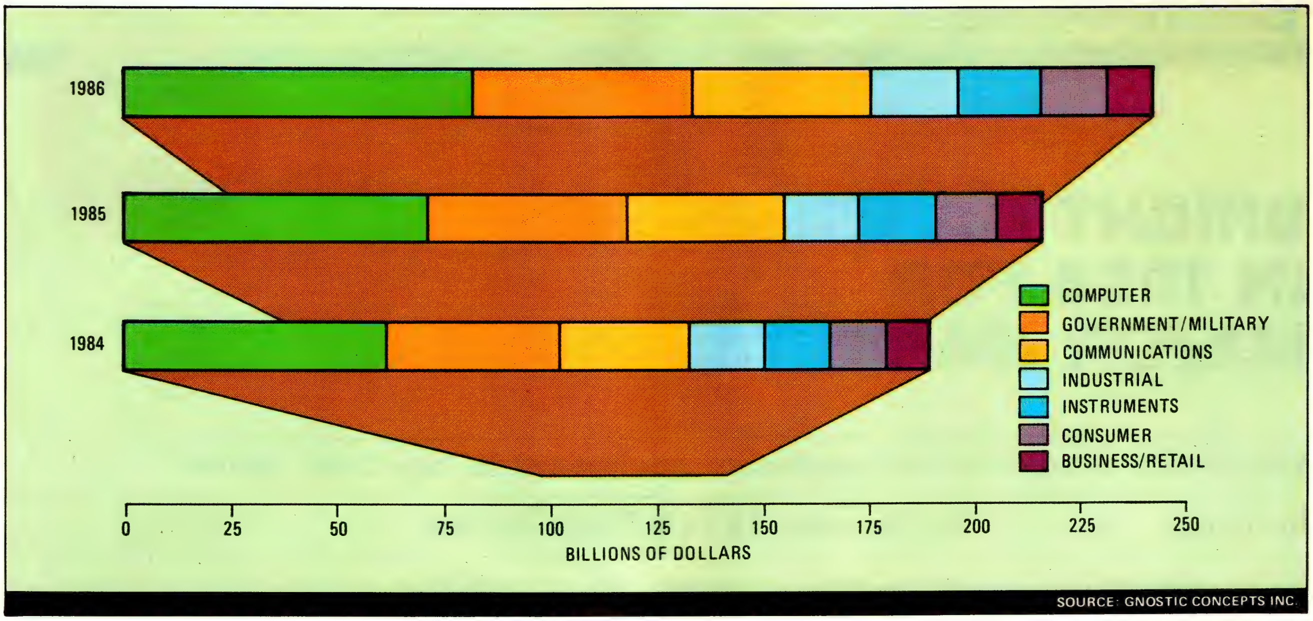
SPECIAL REPORTS

BRIGHT GAINS IN 1985 FOR MAJOR MARKETS

Worldwide production of electronic equipment to top $492 billion in 1985, a gain of 16.2% over 1984's $424 billion

Despite signs of a slowdown in the overall growth of the economy of the U.S. (and thus those of other countries), the electronics industries of the U.S., Japan, and Western Europe continue to move along at a brisk pace. With the exception of semiconductors, which seem headed for a period of slow growth, equipment manufacturers in the three major market areas can look forward to strong increases in demand this year and beyond. The worldwide production of electronic equipment hit $424 billion last year, an increase of 17.8% over the $360.1 billion produced in 1983, according to a recent forecast by Gnostic Concepts Inc., a market research firm in San Mateo, Calif. Looking to this year's performance, Gnostic Concepts projects that worldwide production will increase a further 16.2% to $492.5 billion. This growth won't slow in the near future, either. The research firm foresees worldwide electronic equipment production increasing almost 17% annually until 1988, to a total of $782 billion in that year (see chart). As for the U.S. market, total production of electronic equipment in 1985 should grow 14.5% to $215.4 billion (see chart) from 1984's $188.2 billion (which was up 18% over 1983). Growth in 1986 will slow to 12.5%, bringing the total production in that year to $242.3 billion, Gnostic Concepts says. Of this total amount,





SOURCE: GNOSTIC CONCEPTS INC.

Going up. Despite signs of a slowdown in the U.S. economy, total production of electronics equipment in the U.S. should grow 14.5% this year to reach $215.4 billion compared with 1984's $188.2 billion. Growth in 1986 will slow to 12.5%, bringing the total production to $242.3 billion.

computer equipment will maintain the highest production, at $71.3 billion in 1985, up 16.8% over 1984. For 1986, production should gain another 15% to $82.0 billion.

In the second largest market—government/military—equipment production should advance 13.9% to $46.8 billion this year. An expected gain of 12.1% in 1986 should lift production to $52.5 billion in that year.

The largest rate of gain in U.S. production this year is seen for manufacturers of communications equipment. Production in this sector is forecast to rise 17.5% in 1985 to $37.1 billion from last year's $31.5 billion. Next year, communications equipment production could grow another 13% to $41.9 billion, Gnostic Concepts thinks.

In the fourth largest U.S. equipment category—industrial electronics gear—the firm sees growth in production in 1985 of 12.5%, bringing the market to $18.2 billion this year. For next year, production of industrial electronic equipment is seen growing 10.7% to $20.2 billion.

G. Kent Webb, vice president and chief economist at Gnostic Concepts, notes that "prospects have brightened" over the past few months for the electronics industry, which means it could outperform these projections.

The electronics industry in 1984 benefited from increased capital spending levels as economies strengthened from the recession of 1980 to 1982. But to continue the good growth envisioned by Gnostics' projections, the industry will have to overcome some potential bad news on the spending front. According to the "31st Annual McGraw-Hill Fall Survey of Preliminary Plans for New Plants and Equipment, 1984-86," conducted by McGraw-Hill Economics, U.S. companies expect to increase their capital spending this year by 9.8% to $386.29 billion from last year's $351.65 billion. "That's hardly bad news," the survey notes. "But at the same time, companies think plant and equipment prices will jump 5.3% [in 1985], converting that planned spending increase to just 4.3% after inflation." The survey calls companies' spending estimates "disappointing."

Still more disturbing, however, and possibly more ominous, is the projection that capital spending next year will fall almost 2% to $379.09 billion. McGraw-Hill Economics points out that projections "for more than one year ahead are subject to much change, and usually undershoot the mark." But it adds, "Nonetheless, the 1986 projection is unusually low." **–Robert J. Kozma**

WORLDWIDE PRODUCTION OF ELECTRONIC EQUIPMENT
(Billions of dollars)

Region	Amount (% of total) 1983		Amount (% of total) 1988		Average Annual Growth Rate, 1983–1988
Total	**$360**	**100**	**$782**	**100**	**16.8**
North America	$163	45	$317	41	14.2
West Europe	68	19	131	17	13.9
Far East	80	22	230	29	23.7
Rest of world	49	14	104	13	16.2

SOURCE: GNOSTIC CONCEPTS INC.

GROWTH TO SLOW FROM 1984's RECORD PACE

After more than a year of insatiable hunger for chips, glutted customers have lost their appetite for huge orders of semiconductors, and they are even bickering about the cost. Consequently, many component vendors in the U.S. are finding the prospects for 1985 a little hard to stomach.

The queasiness comes from the drop in bookings that suddenly thudded into place last summer. It hit at a time when many semiconductor fabrication lines were finally making headway on record-long lead times, which had mounted since the start of the explosive 1983 chip-market recovery. Generally, the young personal computer market is getting most of the blame for curbing the fast sales growth it touched off nearly two years earlier. However, many also believe the softening demand for integrated circuits is a problem too deeply rooted to be attributed to any one end-user market.

An *ElectronicsWeek* survey of leading U.S. semiconductor houses indicates the industry continues to scale back dramatically its expectations for growth this year. The view has been bleak enough to trigger layoffs. Texas Instruments Inc. of Dallas is furloughing 2,000 workers this month. Honeywell Inc.'s Synertek Inc. subsidiary in Santa Clara and Santa Cruz, Calif., was placed on the auction block after its consumer chip business tumbled, causing 1,000 workers to lose their jobs.

But if the outlook now seems grim, executives indicate 1984 was far better than they had expected a year ago, mostly on the strength of dramatically increased sales and price levels in the first half of the year.

The poll, conducted in the closing weeks of 1984, shows companies are now projecting that total worldwide semiconductor sales neared the $27 billion mark last year. That represents about a 50% increase over 1983's $18 billion. Predictably, ICs logged the steepest rise in 1984, growing about 55% to just under $21 billion last year. Discretes also showed unusual strength despite an industry trend toward integration. They registered a nearly 29% increase, according to the survey, which placed discrete sales near $6 billion last year.

Total MOS memory chips registered a 44% jump in 1984, reaching $5.79 billion versus $4.02 billion during the previous period. Dynamic random-access memory sales, which were dented by steep price erosion in the final four months of last year, grew 52% in 1984, crossing the $3 billion barrier from $1.98 billion in 1983.

Only read-only memories had weak growth in 1984, caused by sluggish consumer video-game and computer markets. ROMs gained 10%, hitting $530 million. Processor chips—including microprocessors and single-chip microcontrollers—also turned in a good year, with 1984 sales reaching $2.9 billion, compared with $1.9 billion in 1983.

Despite the overall strength of 1984, it's the faltering book-to-bill rate in the fourth quarter that has all but dampened the industry's party mood for the new year. The Semiconductor Industry Association's much-watched ratio indicates the drop in new orders continued in November, hitting an all-time low of 0.61:1.

On that precarious note, semiconductor executives are orchestrating business plans based on a slow first quarter, followed by moderate growth in the second and third quarters. The outlook for the fourth quarter is heavily pegged on the health of the general economy. Any downward swing of the market is expected to trumpet a full-scale 1986 recession. Nearly all long-term scenarios call for a two-year recession followed by a buying surge, around 1988, equal to the one experienced in 1983-84.

But semiconductor leaders are still hopeful of growth next year, according to the survey. In 1985, total worldwide semiconductor sales are expected to rise 7%, climbing to $28.8 billion. Sales of integrated circuits are projected to grow just under 10% to $22.9 billion, while discretes are expected to slip 2% to $5.9 billion.

However, Motorola Inc., which continues to emphasize its broad line of discrete transistors, believes the discrete arena is still showing growth in the mid-1980s, as microprocessors proliferate into new applications. "So we are seeing growth rates in the discrete business that seem to parallel those in integrated circuits, even though some people have prognosticated that it would all go away," says Charles E. Thompson, senior vice president and director of world marketing at Motorola's Semiconductor Product Sector in Phoenix, Ariz. Motorola, however, expects a decline in discrete sales late in the decade as chip integration gobbles up functions and places them on a monolithic die.

The major questions over early 1985 chip markets in the U.S. and elsewhere surround inventory levels and price stability. Thompson, who believes there has been no significant change in real demand over the past year, partly blames chip distributors for touching off a false sense of shortages when they attempted to fill shelves immediately in anticipation of an economic boom.

That caused lead times to swell on many commodity devices from 10 weeks to more than 40. Customers were suddenly ordering more semiconductors because of the long lead times. "So, the incoming orders looked like a big boom," Thompson explains. "It was not that big of a

TABLE 1: WORLDWIDE SEMICONDUCTOR MARKET
(Billions of dollars)

Category	1983	1984	1985	1986	1990
Semiconductors, total	**$ 18.153**	**$ 26.935**	**$ 28.799**	**$ 31.855**	**$ 55.0 – $ 75.0**
Integrated circuits	13.535	20.979	22.867	22.867	47.0 – 63.0
Discretes	4.618	5.956	5.932	6.324	8.0 – 11.0

boom. Our business tracks the business of our customers. If the automotive markets go up 20%, our sales go up 25%, figuring in the increased usage of semiconductor per auto," the executive notes.

Many other semiconductor executives agree, saying the drop in orders is largely caused by customer confidence that chips will be available when needed. William McClean, semiconductor analyst at Integrated Circuit Engineering Corp. of Scottsdale, Ariz., says chip customers are clearly influenced by the knowledge that prices are tumbling. Many orders, sealed in the heat of the summer buying panic, have been canceled, only to be reordered at the lower going price. "What we are seeing is that buyers are sure they can go hand to mouth now, and they are not topping off the tank," McClean notes.

At Signetics Corp. in Sunnyvale, Calif., M. Douglas Rankin, vice president of worldwide sales, blames the slow growth on an inventory-correction problem. "It is very hard to predict exactly how deep it is. There has never been this major a correction in inventory in a strong economic scenario," he states. "There are a lot of new places for inventory, like stores and computer retailers. And also confusing the situation is a new push to reduce inventory in system manufacturing with just-in-time deliveries."

In Santa Clara, National Semiconductor Corp. is looking for the markets to show new life near the end of the first quarter, says Manher Naik, director of strategic marketing. But the growth will still remain below 1984's heated pace, coming in between 10% to 15%, he adds.

Blaming that kind of low growth on price erosion is Herbert V. Criscito, vice president of marketing in the Solid State Division of RCA Corp., Somerville, N.J. "First of all, the personal computer fallout is a factor. Added capacity that is now in place is causing greater availability and pricing attrition in any new orders," Criscito notes.

The spot shortages of some commodity parts, which touched off the bookings hysteria in 1983, are now causing the industry to trudge through this inventory correction period. But things will get better, believes Donald W. Brooks, executive vice president of operations for Fairchild Camera & Instrument Corp.'s North American Semiconductor Division in Mountain View, Calif.

"I think we'll have an inventory correction in the first half—along with the economy probably rolling over and going sideways," says Brooks. "But I'm a little more optimistic, and once we see the interest rates continue to drop, we might see this economy perking up once again."

Gnostic Concepts Inc., a research firm in San Mateo, Calif., that tracks actual consumption of chips (not inventory or devices used in prototyping or sampling), estimates chip usage grew 40% in 1984. While inventories may drop, actual consumption of chips in systems will grow 30% in the coming year, says Mary Lee Wu, managing analyst of the firm's semiconductor group.

Whether or not the economy stays strong, nearly all agree that average selling prices will take a steep fall in 1985, accounting for much of the drop in dollar growth rates. For example, 64-K DRAMs, which were selling for $5 each in 1983, are expected to tumble to an average selling price of $2 to $2.50 in early 1985. In a weak 1986, that price is projected to fall well below $2.

Dataquest Inc. of San Jose, Calif., is projecting that standard discrete bipolar logic will still show an increase despite the falling prices. From 1983 to 1989, bipolar logic is expected to grow at 9.8%, says Andy Prophet, senior analyst in the Semiconductor Industry Service at Dataquest. MOS logic, which consists mostly of CMOS technology, is expected to grow faster, from $497 million in 1983 to $1.4 billion in 1989.

In addition to price erosion, bipolar logic growth is being affected by integration into semicustom logic arrays, the analyst says. "We are not forecasting a peak [for bipolar TTL logic] but a slower growth, tending toward the flat side late in the 1980s," he adds.

–J. Robert Lineback

TABLE 2: WORLDWIDE MARKET FOR SELECTED SEMICONDUCTOR DEVICES
(Millions of dollars)

Category	1983	1984	1985	1986	1990
MOS memory, total	**$4,020**	**$5,790**	**$6,510**	**$7,540**	**$18,000–$28,000**
DRAM	1,980	3,010	3,350	4,000	10,000–13,000
SRAM	590	1,000	1,150	1,300	3,000–4,600
ROM	520	530	560	540	1,000–3,200
EPROM	850	1,040	1,130	1,300	3,000–5,000
EEPROM	80	210	312	400	1,000–2,200
Microprocessors, total	**$1,900**	**$2,900**	**$3,680**	**$4,250**	**$8,000–$13,000**
Microprocessor units					
8-bit	900	1,180	1,340	1,350	1,000–2,200
16-bit	290	440	550	690	2,000–3,000
32-bit	–	–	30	80	300–1,200
Single-chip	550	880	1,100	1,300	2,500–3,300
Others	160	400	660	830	2,200–3,300
Standard logic, total	**$2,950**	**$4,670**	**$5,210**	**$5,720**	**$6,300–$9,200**
Bipolar	2,400	3,860	4,280	4,700	5,500–6,000
CMOS	550	810	930	1,020	1,800–3,200
Semicustom, total	**$560**	**$785**	**$1,290**	**$1,730**	**$2,700–$5,400**
Gate array	355	490	730	900	1,000–1,900
Standard cells	45	75	160	360	1,000–2,500
Fused	160	220	390	470	700–1,000
Full custom	**$700**	**$880**	**$1,200**	**$1,320**	**$2,000–$3,000**
Linear	**$2,700**	**$3,600**	**$3,780**	**$4,200**	**$6,000–$10,000**
Power	**$800**	**$1,040**	**$1,110**	**$1,170**	**$2,000–$3,000**

CHIP MAKERS CONFIDENT ABOUT 1985

In the old days, the ups and downs of the world semiconductor market left many companies feeling as though they'd been battered by an angry storm. As 1985 approaches, Japanese manufacturers seem confident that the latest downturn will be little more than a ripple. "We are not so worried, because the structure of demand has changed radically," says Yoshiyuki Miyatake, manager of strategic marketing for NEC Corp., Tokyo, Japan's leading semiconductor maker.

Just four years ago, consumer electronics products accounted for 58% of total semiconductor demand in the Japanese market; the other 42% was in industrial electronics. By last year, says Miyatake, the ratio had reversed. Industrial electronics accounted for 55% of all demand, and that figure will increase to close to 60% next year.

Japanese chip makers, many of whom admit to inventories of two or three months (six weeks is the norm), still forecast market growth of 20% this year, although a report from the Hitachi Research Institute in Tokyo predicts that integrated-circuit market growth in Japan will slip to 17% by 1986. Other analysts, while agreeing that overall demand will pick up in the second half of next year, still point to four negative factors in assessing the 1985 market. These are:

- Slower growth rates for the U.S. economy, which will affect Japan's own economy. Despite growth this year, at least one research group in Tokyo is forecasting a decline in the growth rate in the overall Japanese economy on a semiannual basis through the end of 1985.
- The U.S. computer market shakeout and other signs of a slowdown in demand, such as cutbacks in the production of video cassette recorders. Makers who in 1984 had been producing at levels close to 50% higher than in 1983 recently began cutting back drastically as U.S. inventories began piling up. One exception is Sharp Corp., Osaka, which is increasing its monthly VCR production from 300,000 to 350,000, about 10% of total VCR production in Japan.
- Expanding Japanese IC production coming on line through 1985, plus new market entrants (such as Ricoh Co. and Minebea Co., both of Tokyo) which are expected to use price cutting as a way of muscling into specific segments.
- Declining product prices, especially in the moneymaking 64-K dynamic random-access-memory chips, which commonly sold for $2.50 late in the summer, and currently are going for close to $2 when ordered in large volumes.

In 256-K DRAMs, Japanese makers and industry sources report that 1985 volume orders now being negotiated are in the range of $10 to $17, depending on the speed and function of the model, and up to $25 for the newest designs.

But this very factor—falling prices—is seen by some as a boost to demand, especially in 256-K DRAMs. IBM-Japan Ltd., Tokyo, is expected this month to start shipping magnetic-disk controls equipped with 256-K DRAMs, and among the Japanese makers, Fujitsu, Hitachi, and NEC already are using 256-K chips in their mainframes and public branch exchange models.

Moreover, as these leading makers, along with Toshiba Corp., Kawasaki, realize higher yields on 256-K DRAM products—insiders say the present average figure is 40%, which will grow to 50% by next spring and exceed 65% by the end of 1985—they're stepping up production. Hitachi, Fujitsu, and NEC all are producing close to 2 million 256-K units a month right now, and by the end of next year, NEC plans to be turning out between 4 million and 5 million each month. A recent report covering all Japanese makers noted close to 30 projects in which existing plants producing discrete, memory, and microprocessor units will be expanded, or new ones built, over the next two years. And total production was already up 59% over 1983.

TABLE: ESTIMATED 1984 WORLDWIDE TOP-10 SEMICONDUCTOR COMPANIES

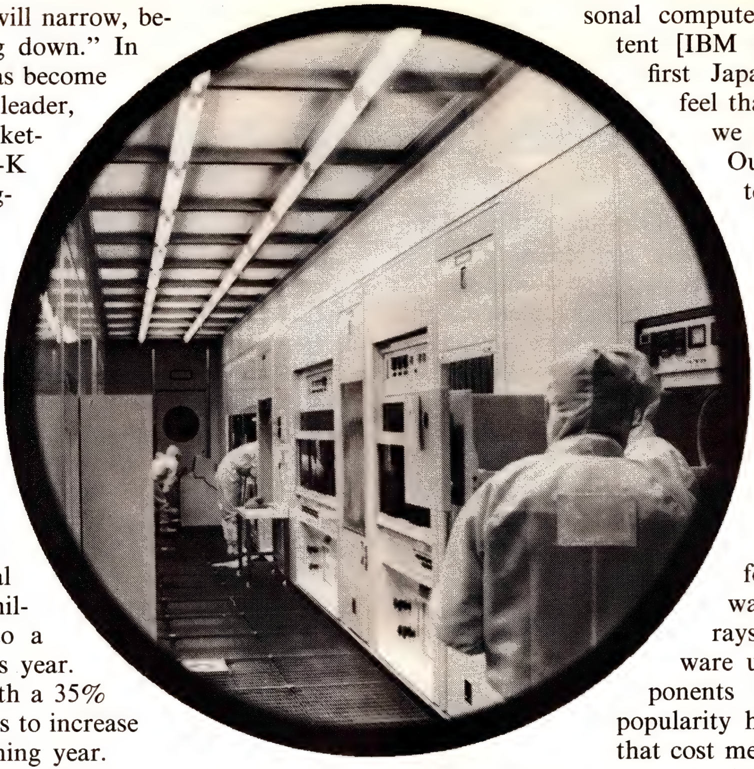
Rank	Company	Est. 1984 Total Semiconductor Production (Millions of dollars)	Location
1	Texas Instruments Inc.	2,350	U.S.
2	Motorola Inc.	2,255	U.S.
3	NEC Corp.	1,985	Japan
4	Hitachi Ltd.	1,690	Japan
5	Toshiba Corp.	1,460	Japan
6	National Semiconductor Corp.	1,270	U.S.
7	Intel Corp.	1,170	U.S.
8	Philips*	1,150	Europe
9	Advanced Micro Devices Inc.	935	U.S.
10	Fujitsu Ltd.	815	Japan

*Including Signetics Corp.

SOURCE: INTEGRATED CIRCUIT ENGINEERING CORP.

NEC invested $583 million this year in new facilities, and will invest about the same amount in 1985. Figures for Hitachi Ltd., Tokyo, and Toshiba are also in the $550 million range for this year, with similar investments planned in the next 12 months.

"There may be some overproduction and price cutting, especially in memory products, but this is merely a market adjustment," says Tsuyoshi Kawanishi, director of Toshiba's Semiconductor Group in Tokyo. Semiconductor growth in Japan will be 20% to 25% in 1985, he maintains, "but profits will narrow, because prices are coming down." In static RAMs, Hitachi has become the world production leader, especially in the market-leading slower 64-K SRAM products. In logic, the TTL shortages of six months ago have now turned into oversupplies, and manufacturers such as Texas Instruments, Fairchild, Fujitsu, and Hitachi leveled off production last year. The microprocessor market, which grew close to 60% last year with total sales in Japan of $979 million, will slow down to a still-impressive 35% this year. NEC led the market with a 35% share in 1984 and it aims to increase that to 40% in the coming year.



Tranquil. Japanese semiconductor makers are confident that the latest downturn in the markets for their products will be little more than a ripple in their long-range projections for domestic and international chip demand.

"The Japanese are trying to free themselves from dependence on American-based devices, as their efforts to develop 32-bit-based microprocessors shows, but they still have that IBM-compatibility problem to deal with," points out securities analyst David Keller of James Capel & Co.'s Tokyo office.

NEC's Miyatake agrees, to a point. "There are two microprocessor markets," he argues. "Inside Japan, IBM is not dominant. Their share in business computers is 25% and weakening; their share in mainframes is 20% to 25% and not growing; and their share in personal computers is virtually nonexistent [IBM has just announced its first Japanese product]. So we feel that inside Japan, at least, we can win this battle." Outside Japan, he admitted, "if IBM has a 50% share, we must follow."

Gate arrays are a strong growth market also, says Sutezo Hata, executive managing director of Hitachi's Electronic Devices Group in Tokyo. Hata and other industry analysts point out that as manufacturers have found more economical ways to produce gate arrays, and as the cost of software used to design the components has come down, their popularity has increased. "Software that cost me $5,000 earlier this year may be less than $500 by next year," says a U.S. semiconductor executive in Tokyo.

Despite the negative factors that appeared in the second half of 1984, therefore, the long-range positive points—much greater industrial product demand, higher yields, and new markets for semicustom and custom chips—are pulling companies into the semiconductor field, not out of it. "We still had new entries into the market this year, and even the big names, like Hitachi, are converting color-TV [production] lines into VLSI lines," notes Keller.

–**Michael Berger**

Expanding. A recent report covering all Japanese semiconductor manufacturers found close to 30 projects in which existing plants producing discrete, memory, and microprocessor products will be expanded, or new ones built, over the next two years.

CHIP MAKERS SEE ‘NOT A BAD YEAR’ IN 1985

For European semiconductor producers, 1984 was a bumper year because markets grew by as much as 50%, reaching new highs in volume. Order books became bloated, and book-to-bill ratios, which measure the relationship between orders and shipments, went as high as 1.8:1. Long delivery times were the order of the day.

The big demand for semiconductors—from makers of personal and office computers as well as manufacturers of peripherals such as printers, keyboards, and floppy-disk drives—led to worldwide shortages, especially for standard logic integrated circuits, memories, and certain microcontroller chips. As a result, production facilities were expanded to cope with the growing demand.

Once all the figures are tallied, Europe's market for integrated and hybrid circuits will probably reach the $3.27 billion predicted for 1984 by market-research firm Benn Electronics Ltd. in its annual look at the market. As in the U.S., the growth rates will decrease this year, and product shortages will ease or even disappear. “The prices for most products will again follow the learning curve,” adds Gernot Oswald, executive director for semiconductor marketing at Siemens AG, Munich.

Despite this, however, European semiconductor makers are not overly concerned, and the consensus is that 1985 will not be a bad year. The semiconductor market is merely going “from a boom period into a phase of healthy growth,” says West Germany's Central Association of the Electrotechnical Industry in Frankfurt.

Stocks will adapt themselves to what the equipment makers need, and that will lead to an orderly demand, which in turn will enable producers to adjust delivery times to customers' requirements, the association says.

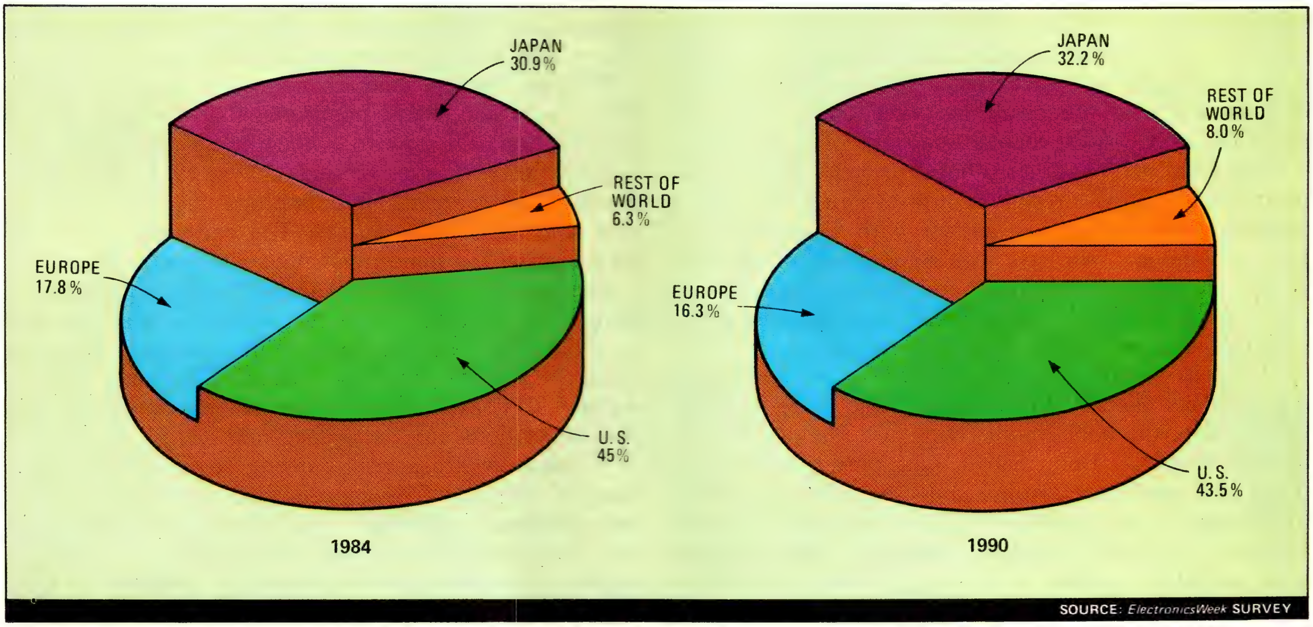
The integrated circuits market (including that for hybrids) will grow this year by almost 15.5%, projects Benn Electronics. That will lift it to about $3.8 billion in 1985. Some forecasters, however, estimate Europe's total semiconductor growth at more than than 20%.

In West Germany, the association pegs the country's total components consumption in 1984 at about $3.8 billion, a 23.9% increase over the 1983 figure. If the consumer sector once accounted for the biggest share of components sold, now data-processing and office equipment consume the largest share of devices—36% in 1984. Next comes telecommunications with a 28% share and industrial electronics with a 26% share.

For semiconductor makers in West Germany, 1984 was a turbulent year. The market shot up about 45% over 1983 figures, pushing sales to $1.3 billion. ICs rose even more sharply—54%. Domestic sales came to $920 million, according to the association.

Despite these staggering increases, Günter Schmitt, the ITT Semiconductor Group's marketing manager for West Germany, refuses to call 1984 a genuine boom year. “The real boom, one triggered by true demand, occurred in the U.S.,” he says. That has kept U.S. firms from shipping large quantities of parts to Europe.

The high value of the dollar, which made U.S. exports more expensive, also helped keep U.S. products from flooding Europe, Schmitt says. “A genuine demand will come in 1985,” he says. The television industry, after a lull of several years, is expected to take off again; telecommunications will start to climb, and the automobile industry will turn into a big-volume customer for semiconductor products, Schmitt predicts. West Germany's



SOURCE: *ElectronicsWeek* SURVEY

Shrinking. Europe's consumption of semiconductors will drop from 17.8% of total consumption in 1984 to 16.3% in 1990, while U.S. use will also dip to 43.5% of the total in 1990 from 45% last year. Japan's consumption will rise from 30.9% to 32.2%.

Still hot. Increased demand for semiconductors from equipment manufacturers in areas such as consumer electronics, telecommunications, and automobiles as well as computers will keep European chip producers busy this year, executives believe.

1985 semiconductor market will rise between 15% and 18%, Schmitt predicts—which agrees with estimates from other German marketing officials.

After the euphoria of a record-breaking 1984 in which the UK market expanded 55% in dollar terms and 73% in local currency, semiconductor makers are entering 1985 in a period of uncertainty as book-to-bill ratios slide below parity. In 1984 new production facilities opened while demand slackened, and component buyers, who saw prices slide 25% to 35% (for 64-K byte memories), canceled old orders and rescheduled new ones, giving the downward spiral an extra twist. The market has been overreacting, and the result has been chaos, says one executive at SGS-Ates, echoing the views of many others.

Chip firms will have "six months of hell," but the lack of orders is not the forerunner of a severe recession, says Malcolm Penn, a market analyst with Dataquest UK Ltd. in London. "We have seen six quarters of unprecedented growth, inflated prices, and lead-times [stretched] out to 50 weeks. What we are seeing now is a natural readjustment to an artifical situation," he says.

A market-research manager for one of the industry's top suppliers agrees. "My opinion is the same as a few months ago: the book-to-bill ratios just cannot continue upward forever." Dedy Saban, vice president, International Semiconductor Group, and director of marketing for Europe at Motorola Inc.'s European Semiconductor Division, pegs the UK market growth at 20%, good by most industry's standards, but still a steep slide from 55% in 1984. "I am optimistic for 1985, mainly because of a strong order backlog," he says. "If the softness in bookings carries on for more than three months," the executive warns, "we could be at the start of the next cycle in demand."

West Germany is still the largest European market, with sales of $1.28 billion, but the UK has caught up fast and now consumes $1.11 billion, followed by France at $670 million, according to Saban. In the UK, the personal computer sector doubled its chip consumption while most other sectors performed well, with the automotive sector making a strong showing, he adds.

As in the rest of Europe, French components bookings in general, and for semiconductors in particular, are falling fast. However, an enormous influx of orders during last year's first half will keep growth of French semiconductor production above 25% after a rise of more than 30% in 1984. These figures look particularly good in light of the distribution of French production, of which slightly less than half is currently devoted to integrated circuits.

More good news is that French manufacturers will continue to export nearly 25% of their production and that by the end of this year, both of the country's principal semiconductor houses, Matra-Harris Semiconducteurs and Thomson-CSF, should be in the black. Matra-Harris, Paris, will post a profit for 1984. Both companies are making significant inroads into the gate-array market, and Thomson will debut in the dynamic random-access memories market for the first time this year.

Philippe Dauvin, chief economist at Thomson's components division, Paris, points out that domestic French consumption will slow to a nonetheless respectable gain of 20% this year, after soaring 35% in 1984. Driving the French market are strong data-processing, office-automation, and automotive sectors. The consumer sector has been lagging for some time—that will continue.

The Italian market last year chalked up a phenomenal growth rate of 50%, although growth this year will cool to about 20%, expects Enrico Villa, director of market research at SGS-Ates Componenti Elettronici SpA in Agrate. That expansion will be fed mostly by the telecommunications and data-processing sectors, he says.

"Computers are a real growing sector, and in Italy most of the growth is concentrated on small machines and peripheral equipment," Villa points out. "The question mark is whether or not this [growth] will continue because there are significant stocks of personal computers worldwide that could lead to some price decreases in 1985. In the long term, though, [demand] can only continue to grow."

–John Gosch

SIGNIFICANT GROWTH COMING IN 1985

All three computer markets—microcomputers, minicomputers, and mainframes—will experience significant growth in the coming year, according to industry executives. In the microcomputer area, growth estimates range from approximately 40% to around 60%, and some vendors believe the increased use of local-area networks, increased capabilities through integrated software and communication to the outside world, along with user-friendly interfaces, could spur even greater growth.

In the mainframe market, estimates of growth vary from nearly zero to 16%. Whether or not IBM Corp., Armonk, N.Y., introduces a new mainframe system early in the year is a critical factor. While some observers believe sales in the mainframe market will remain the same in 1985 as in 1984, others support IBM's contention that mainframe sales will actually be sparked, rather than slowed, by the increasing capabilities and lower prices of microcomputers and minicomputers.

Analysts expect IBM to stay number one in microcomputers and mainframes, with 40% and 75% of these areas, respectively, and to keep a stride behind Digital Equipment Corp., Maynard, Mass., in minicomputer sales (with 21% of the market versus DEC's 22%). Apple Computer Inc., Cupertino, Calif., is expected to retain its 20% portion of the microcomputer market, while some analysts expect New York's AT&T Co. and ITT Corp. to be found among the top makers, along with Commodore International, Tandy, Hewlett-Packard, DEC, and others that have claimed significant portions.

Executives and analysts expect increased integration in systems, components, and units such as voice/data work stations, more modularity in design, and higher storage capacities for lower prices. Also likely to be found on computers will be more customized user interfaces and more standard features, such as bit-mapping and windowing.

Continuing advances in hardware and software technologies and decreasing prices will make the purchase of a system more justifiable for homes, schools, and offices. Communications capabilities, such as local-area networks and links to information and services, will pull customers closer to a computer store. Also, microcomputer prices are dropping steeply; an Apple system that sold for $2,000 a year ago now sells for $1,300, and last summer IBM Corp. cut prices of its Personal Computers by 18% to 23%. The Gartner Group Inc., a Stamford, Conn., market research firm, sees growth in the microcomputer market reaching $14.8 billion, a good 50% above last year's sales.

For single-user systems priced under $10,000, Dataquest Inc., a San Jose, Calif., market research firm, expects sales to jump from $27 billion in 1984 to $45.3 billion in 1985, a growth rate of 67.7%. The firm expects an especially strong performance from the $5,000 to $10,000 market, which it says will increase from $22 billion to $36.9 billion. Dataquest also expects sales of business computers priced from $5,000 to $30,000 to increase from $3.4 billion to $4.9 billion, a rate of 42.4%. Less enthusiastic is InfoCorp, a market research firm in Cupertino, which expects microcomputers in average configurations to increase from $18.9 billion to $27.2 billion, a growth rate of 44%.

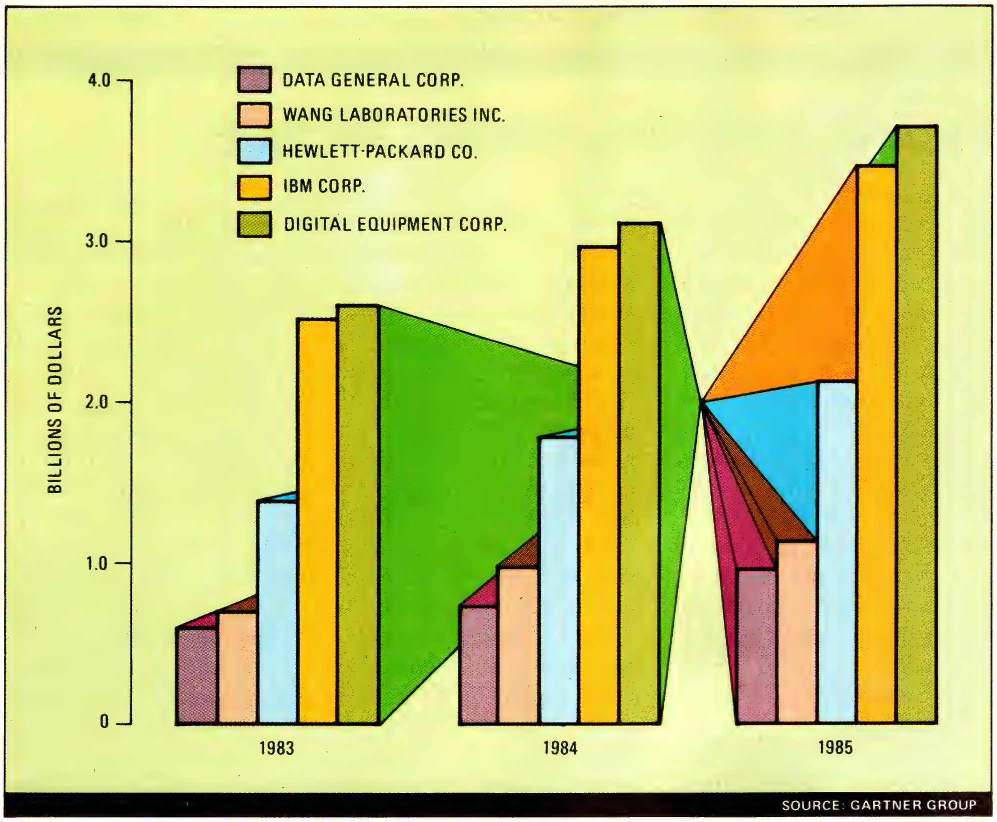
Some executives believe the computer industry promised more than it could deliver over the past few years, which was why U.S. sales did not reach the heights people expected. "The personal computer market was oversold, and the infatuation period is over," says David Kay of Kaypro Corp., Solana Beach, Calif. Kay points out that the average user must enlist the help of a "hacker" to set up functions such as electronic mail and information services. "The technology is there. Functions just need to be made more automatic so you don't have to change disks and hassle." Kay expects an "exponential rise" in the sale of personal computers beginning in the summer of 1985, when a substantial amount of new integrated software hits the market.

Currently, 300 firms are selling personal computers in the U.S, says Dataquest's Norman R. DeWitt, adding

TABLE: U.S. DATA-PROCESSING-EQUIPMENT MARKET
(Retail prices in millions of dollars)

Category	1983	1984	1985
Single-user systems, total	$13,800.0	$27,000.0	$45,300.0
under $1,000	1,200.0	1,600.0	2,500.0
$1,000 to $5,000	10,800.0	22,000.0	36,900.0
$5,000 to $10,000	1,800.0	3,400.0	5,900.0
Very small business computers, $5,000 to $30,000 (includes 8- and 16-bit multiuser systems, supermicros)	$ 2,291.6	$ 3,397.1	$ 4,891.5
Small business computers, $30,000 to $80,000 (includes supermicros and minicomputers)	$ 6,555.0	$ 6,358.0	$ 6,040.0
Large business computers, $80,000 to $380,000 (includes minis and superminis)	$ 7,200.0	$ 9,438.0	$11,982.0
Commercial systems and mainframes, over $380,000	$14,300.0	$15,600.0	$16,800.0

SOURCE: DATAQUEST INC.



SOURCE: GARTNER GROUP

Number 2. Despite its dominance in the personal computer and mainframe areas, IBM Corp. this year will continue to trail industry-leader Digital Equipment Corp. in the minicomputer market, according to Gartner Group projections.

that he expects the number to remain about the same in 1985. Of those that enter, DeWitt thinks most will pursue niches. The Gartner Group expects IBM, with 40% of the market in 1984, to drop to 38.5% in 1985, and Apple to increase its share from 15% to 17.8%. The Gartner Group also expects Commodore to drop from 10% to 8.4%; Tandy to remain close at about 6%; and H-P, DEC, Wang, and Compaq to retain about the same shares they had in 1984.

DeWitt expects IBM to increase its share of the personal computer market by 4% to 6% to about 40% in 1985. "In 1982 and 1983, people bought other brands because they couldn't get an IBM PC," he says, adding that IBM can now satisfy users' demand. He thinks Apple will lose about 2% in market share in 1985, which IBM will pick up.

Many executives and analysts expect continued consolidation in the industry. Thomas Hill of Hewlett-Packard Co., Palo Alto, agrees with industry watchers' projections that by 1989 four key vendors will have captured 80% of the office automation market, paralleling events in the automobile, television, and other industries. George Stack, vice president of ITT Information Systems, notes that many small firms can develop one or two outstanding products, but most cannot keep up the innovation and investment rate of large firms. Says Edward Colby, product manager for Apple's IIc, "The industry will grow strongly, but there will be fewer, but stronger, players."

ITT and AT&T will gain significant market share in 1985, and each have 10% of the market within a few years due to their strong direct-sales forces, network support, and extensive resources, according to DeWitt. The corporate giants have just begun building distribution channels, while IBM has had its for three and a half years, he points out. "Firms that don't have a direct-sales force have a big challenge. In 1984, IBM's direct-sales force sold 40% of PCs, up from zero in 1981," says DeWitt. Apple will also be helped by the direct-sales force it is building, and Tandy Corp., Fort Worth, Texas, with its reorganized marketing structure, the addition of some MS-DOS-compatible products, and aggressive pricing will perform better, DeWitt thinks.

As for the minicomputer market, the Gartner Group expects it to grow 16% in 1985 to $16.5 billion, while InfoCorp thinks sales will increase from $10.4 billion to $11.2 billion, a rate of 7.7%. The Gartner Group expects companies to keep generally the ground they held in 1984. It anticipates that DEC, with 22.2% of the market, will stay a step ahead of IBM (21.0%), and projects that H-P will take a 12.5% share and Wang a 6.6% chunk. Gartner thinks Data General, Burroughs, Prime, and Tandem will each take approximately a 4% to 6% share, and other vendors will combine to capture 19.9%.

Microcomputers and supermicrocomputers, with increasing capabilities and lower prices, are helping to restructure the minicomputer market, says Dataquest's James Renalds. He notes that prices in the small-business market aren't falling as fast as in the personal computer area: "The supermicros are eroding the low-end mini market." As a result, Dataquest expects sales of business computers, including supermicrocomputers and minicomputers priced from $30,000 to $80,000, to fall from $6.4 billion to $6 billion. At the high end of the market, however, Dataquest expects sales of business computers, mainly minicomputers priced from $80,000 to $380,000, to jump from $9.4 billion to $12 billion.

Agreeing with IBM that the proliferation of microcomputers and minicomputers will increase the need for mainframes, the Gartner Group expects this mainframe market to grow 15% in 1985 to $27.8 billion. Gartner expects IBM, with 76% of the market, to introduce a significant new mainframe during the year, which will spur growth. A smaller increase in market size is foreseen by Dataquest, which expects commercial system and mainframe sales to increase at a rate of 7.7% to $16.8 billion in 1985.

–Steve Haggerty

PRODUCTIVITY BOOST IS FUELING GROWTH

The data-processing market in Japan is once again moving along at a fast clip as Japanese companies, proud of the gains they have made in recent years in increasing productivity in the factory, are sorely aware of the need now to extend that productivity to the office.

The computer market in Japan, not including peripherals, totaled $4.9 billion in 1984, up 22% over the previous year, estimates Sanyo Securities Co. Growing only 7% in 1983, the computer industry experienced an extremely strong recovery as a whole in 1984 and growth of 15% to 20% will continue into 1985, analysts say.

Middle- and high-end mainframe computers (those costing more than $160,000) make up about 25% of the installed base of the Japanese computer market. In that segment, IBM-Japan Ltd., Tokyo, remains the leader. In 1983, IBM held a 27.7% share of the mainframe market. Fujitsu Ltd., Kawasaki, was second with 20% and Hitachi Ltd., Tokyo, third with 17%. Tokyo's NEC Corp. and Nippon Univac Kaisha Ltd. made it into the top five with market shares of 17% and 16%, respectively. Fujitsu has slowly been strengthening its market position against IBM, but "will get no more than a point this year" in market share, says Mark Kopinski, an analyst with Sanyo Securities.

At least partly because of the industry recession, growth in the Japanese mainframe market has been sporadic in recent years, but the market seems to be turning around, analysts say. Growth was 13% in 1984, and will remain in double digits at least for the next several years.

One reason, says Kopinski, is that Japan is rapidly moving toward a "cashless society," through computerized direct withdrawals from savings accounts by major department stores, securities firms, and the like. Further demand for high-performance computers will be pushed along by the booming telecommunications industry in Japan, he says.

Finally, as Japanese industry continues to expand and companies move from centralized computer operations to decentralized and more complex functions, the demand for mainframes will continue to grow. Indeed, a survey of 391 major firms conducted by Nihon Kezai Shimbun showed that more than 70% hoped to buy new and faster mainframes soon.

But far outshining the mainframe movement is the explosion in the personal computer market in Japan. The race is on to capture the broad-based market for office automation, at the heart of which are small office and personal computers.

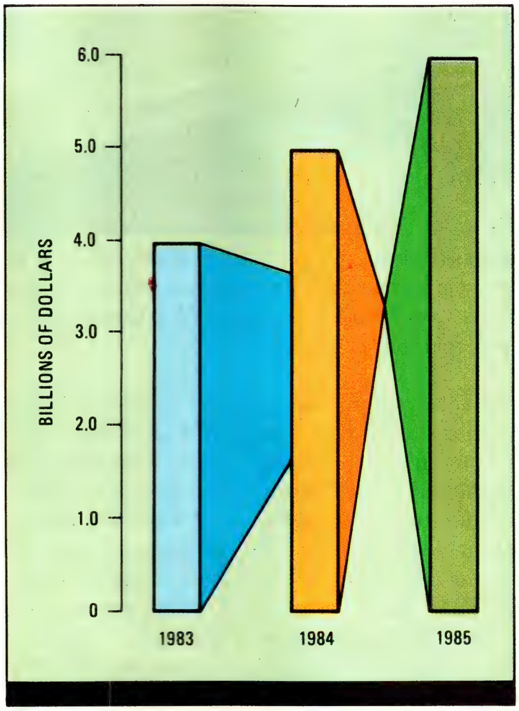
Personal computer shipments in Japan will reach some $1.3 billion in 1984, up 32% over 1983, according to the Japan Electronic Industry Development Association. JEIDA predicts sales growth to exceed 25% yearly through 1988. A recent Labor Ministry survey of some 2,000 firms with 100 or more employees showed that 36% of the polled firms already had personal computers.

Although demand from the home market for personal computers is slowing, demand from business is picking up and the market is clearly moving away from low-priced models toward the higher-priced, higher-performance 16-bit units. NEC, which claims to own as much as 90% of certain segments of that market, late last year revised downward the number of units it expected to sell in 1984. But it revised upward the estimated revenues from personal computer sales to $125 million, an increase of 33% over 1983. NEC offers four of the five most popular models of personal computers nationwide and has a formidable sales and service network.

In contrast to NEC's strength in the Japanese personal computer field is IBM's weakness. In early November, IBM-Japan introduced its 16-bit JX model with a flurry of advertising, but up to now, sales for the JX and the IBM Personal Computer have been slow. IBM's share of the high-end office computer market, headed by its model 5550, reportedly has slipped to 25%, while NEC and Fujitsu retain a 30% share each.

The other leading U.S. personal computer maker, Apple Computer Inc., is but a ghost in Japan. Sales of Taiwan-made Apple II clones flourish in the discount outlets in downtown Tokyo, but otherwise, hardly an Apple is to be seen. The problem, again, has been lack of Japanese-language software and sales outlets. "No software, no service, no sales," admonishes a JEIDA official. Apple recently signed a distribution agreement with Canon Sales Co., a copier maker, which has perhaps the best office-equipment sales network in Japan. However, Canon plans to sell its own personal computer that will compete with Apple's Lisa and Macintosh.

–Jonathan Joseph,
McGraw-Hill World News



Buoyant. The computer market in Japan, not including peripherals, increased over 22% in 1984 to a total of $4.9 billion, and it could increase another 15% to 20% to $5.8 billion in the coming year.

EUROPE'S COMPUTER DEMAND UNDIMINISHED

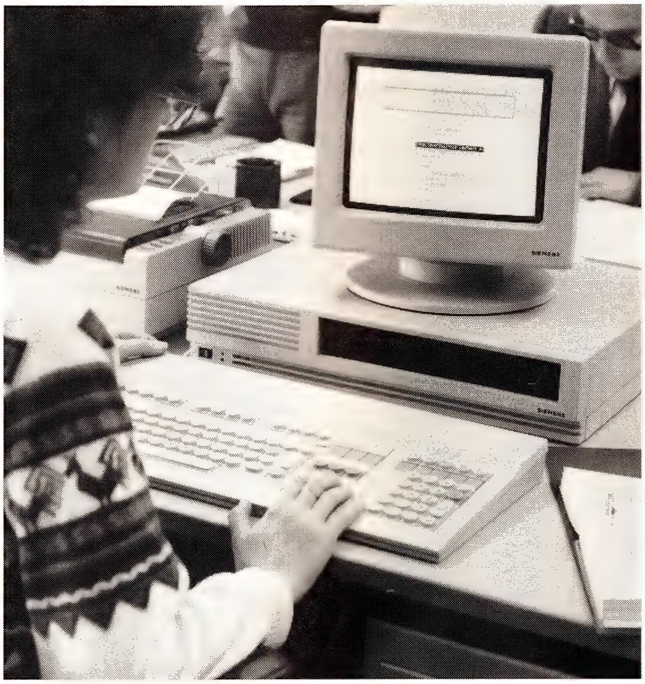
Europeans are showing an undiminished appetite for data-processing equipment. In 1983, they spent $36 billion on hardware and services, and by 1989, they will be spending around $110 billion, for a compound annual growth rate of 20%, according to market watchers IDC Europa Ltd. in London.

Though the prospect of healthy growth should be good news for European suppliers, a recent survey by London research firm Logica Ltd. notes that 70% of Europe's supplies comes from non-European firms and only in a few sectors, such as electronic typewriters, and personal computers, have Europeans managed any significant market presence.

One problem is that Europe's traditional mainframe computer manufacturers have been slow to move into the higher-growth sectors. The UK's flagship computer company, International Computers Ltd. plc, for example, managed only an 8.3% growth between 1983 and 1984, though profits were up 20%. Its DM1 and Estriel multiprocessor systems, due out next year, are expected to give the ICL mainframe line a much-needed boost. But if the company is to have any chance of keeping up, it must score soon—with its multiuser microcomputer line, its IBM Corp. Personal Computer look-alike, and its new One Per Desk work station.

Most market growth is coming from the two extremes of the computer spectrum—giant systems costing over $1 million and personal computers costing a few thousand, says Derek Pedder of London's BIS-Pedder Ltd. Sales of single-user computers, he says, are becoming significant in dollar as well as unit terms, up from 9% of the total European market in 1983 to 23% in 1989; by then, sales will approach the expenditures on large-scale multiuser systems of the IBM 30XX type.

But the competition is intense, and with Big Blue now putting its IBM brand on the personal computer sector, a shakeout cannot be far away. According to one new survey from Britain's National Computing Centre in Manchester, there are more than 434 brands of single-user systems in the UK, including 80 portables and 44 programmable word processors.



Quenchless thirst. The demand for single-user data processing equipment in Europe continues unabated, with personal computers for office automation uses, such as the PC-D personal computer from Siemens, doing particularly well.

Starting from nowhere in the UK computer market just over 18 months ago, IBM has cut through the pack to challenge the local hero, Applied Computer Techniques Ltd., Birmingham, for the top spot. Until then, ACT had an annual growth rate of 70% for the last 11 years. But its first-half figures showed that its growth rate had slowed.

"We have each got around 35% of the UK market," says Jess Dorell, ACT's group marketing director. He believes that new products launched earlier this year—an Apricot portable and a new entry-level machine, the Apricot F1, as well as the industry's first implementation of Microsoft's networking software—will restore ACT's momentum. In 1985, the personal user market in the UK should double, says Dorell.

In the home computer sector, UK firms Sinclair Research Ltd. and Acorn Computers Ltd. were in close competition with Commodore International Ltd., just about the market leader, and both unleashed expensive advertising campaigns for the annual Christmas buying binge. But the Japanese, with their MSX system, are now rearing their heads above the parapet. UK companies say MSX gear is too expensive, but with their polished marketing act, the Japanese will undoubtedly take their share of a market that many predict has reached its peak. Pedder, for one, believes the market will move to more expensive models, while unit sales may be cut in half. Thus, the UK, where the home computer boom first got under way, may also be the first European country to witness a shakeout.

"The demand for data-processing equipment continues to expand," concludes a report prepared by West Germany's Central Association for the Electrotechnical Industry. Supporting its assessment with figures, the Frankfurt association says incoming orders for the German data-processing industry were 27.8% higher during the first eight months of 1984 than for the same period in 1983. Orders from abroad rose even more—by 31.5%—than domestic orders. This can be attributed partly to the strong U.S. dollar, which makes German goods less expensive on dollar markets.

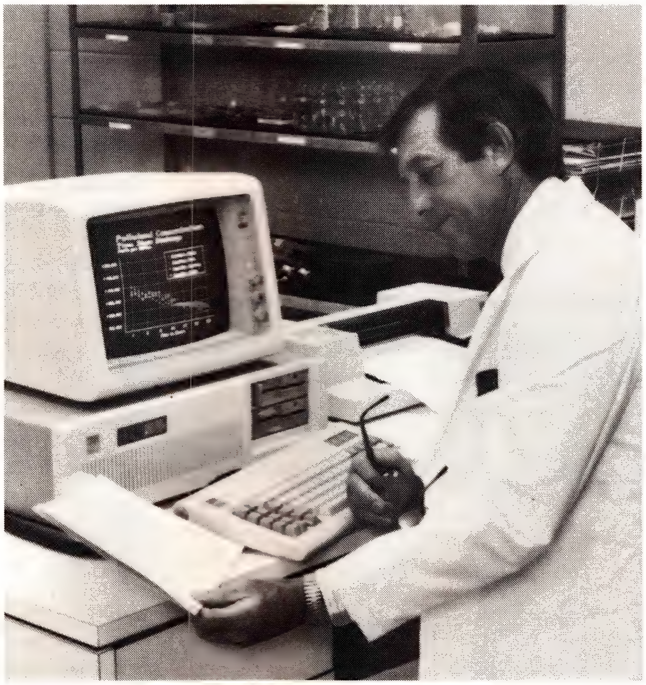
"These figures confirm that the acquisition, processing, transmission, and storing of information have become key functions in our economy," says Karl Döring, head of the association's data-processing section. Computers are increasingly being accepted as problem solvers, and for improving productivity and competitiveness as well as for humanizing the workplace in industry and business, he adds.

Not surprisingly, sales by computer firms producing in West Germany rose 23% during the first eight months of 1984, corresponding to a production volume during that period of $3.15 billion. Total production in 1984 should come to about $5 billion.

The West German data-processing market will grow from $4.18 billion in 1984 to $4.58 billion in 1985, predicts the association. Thereafter, it should rise at least 9.5% a year in real terms for the rest of this decade. The market volume in 1990 should be about $7.27 billion, the association adds. This growth is more than double that of West Germany's overall electrotechnical industry.

The push will come mostly from medium-size machines and personal computers, but also from office machines, data-processing equipment, and communications gear merging into single systems. Also providing an impetus for growth will be graphics systems as well as computer-aided design and manufacturing gear.

The personal computer market is one of the fastest rising sectors in Europe. Its dramatic growth should be sustained well into the 1990s, predicts Intelligent Electronics Europe, a Paris market research firm. Personal computers have begun to make their presence felt in large companies in most European countries and that presence will continue to be strong. Projections for 1990 call for more than 3 million units to be shipped and the installed base to exceed 11 million systems by the end of that year, the firm says.



Laying siege. Having moved into the dominant position in the U.S. personal computer market, IBM Corp. will continue its attack on the European market with its Personal Computer, designed for uses ranging from the office to the laboratory.

The French data-processing market has leveled off recently at a growth rate of about 15%. This figure looks strong compared to the French economy's lackluster performance in general and in the context of inflation that could fall to 6% next year. That growth, however, is not evenly distributed throughout the computer industry.

"We've noticed a phenomenon in France that doesn't seem to be coming out in most market assessments that originate from the U.S.," points out François Piffaut, marketing manager for the Bull group's French sales network. "By that I mean that the growth rates that we're looking at in very large systems for scientific use, and smaller systems like those being used in distributed data-processing networks, is superior to that of smaller and middle-range minicomputers."

Piffaut explains that as microcomputers become more powerful, they tend to absorb some of the market that minicomputers formerly served. Consequently, the largest systems next year should grow at least 20% over 1984, while smaller equipment sales may rise by 25%. Standard minicomputer systems—which still claim the lion's share of the French market—will have a below-average market expansion of about 13% next year.

The most important market will continue to be the industrial sector, which represents 30% to 35% of the total French consumption and with a slightly above-average growth rate of 16% or 17%, Piffaut says. Education and research are two up and coming sectors, in which the use of microcomputers and large systems, respectively, will grow at about the same rate as the industrial sector's, he points out. In addition, he predicts an expansion of distribution services, a sector that has long been underequipped; health care, currently a very small part of the market, is expected to expand in 1985 by at least 20%.

In Italy, the market looks surprisingly different from the French market—the key difference is in personal computers. According to Alberto De Macchi, manager of macroeconomic and strategic research at Ing. C. Olivetti & Co., SpA, in Ivrea, personal computer sales rose by a whopping 60% in 1984 over the previous year and that growth will slow very little—to about 50% in 1985. This is because in Italy, more than in France, personal computers are often used as central computers for small businesses.

Olivetti commands much of that market with its IBM-compatible M-21 and M-24; it produces the M-24 under AT&T Co.'s label as the PC6300. But in 1985, the Italian company will be girding itself for its first real personal computer battle with IBM. "Last year, IBM did not have its own distribution network for PCs, but this year it finally established a significant presence in that market," says De Macchi. The fact that IBM is trying to sell PCs in place of programmable terminals "makes the market very difficult to keep track of," he adds.

Olivetti expects growth in the Italian data-processing and office-automation markets to stay between 15% and 18%, as they were in 1984. But it expects those markets to be better balanced, as data-processing and office automation systems replace bottom-of-the-line products such as cash registers and typewriters. **–Kevin Smith**

STRONG GROWTH SEEN FOR LANs, PBXs

The proliferation of personal computers that has taken place so far, and the expected boom in demand this year and in future years, bodes well for one part of the communications equipment market—that of local-area networks, or LANs. As more microcomputers penetrate corporate America, the need to tie them together increases. The Ethernet system, first promulgated by Xerox, Digital Equipment Corp., and Intel, as well as other systems, including IBM Corp.'s PC Network for its growing line of Personal Computers, promise to boost the popularity of LANs.

Dataquest Inc., the San Jose, Calif., market research firm, lists LANs as one of the fastest growing segments of the communications equipment market during the next few years. According to Dataquest, the LAN market totaled just $140 million in 1983, but, with a compound annual growth rate of more than 48%, the LAN market should surpass more than $1 billion by 1988.

Vendors of LANs also expect a boom, starting in 1985. Nestar Systems Inc. of Palo Alto, Calif., expects at least to double its revenues for LAN products this year. 3COM of Mountain View, Calif., which makes broadband LANs, is growing at a rate of 300% per year. Another firm based in Mountain View, Sytek Inc., a manufacturer of broadband LANs and the developer of IBM's PC Network, has doubled its revenues every year since 1979.

After something of a lull in 1983, the market for private branch exchange (PBX) equipment, the second largest segment of the communications equipment market, increased between 25% and 30% last year, industry sources indicate. Vendors' heightened activity in this market—including IBM's acquisition of Rolm Corp. of Santa Clara, Calif.—promises an increase in new products that should maintain momentum for some, while other players could fall by the wayside. According to Dataquest, the market for voice PBX systems (which can also carry data) should grow at a compound annual rate of almost 8% to $4.1 billion from the 1983 market of $2.8 billion. Data PBXs will advance by 40% to $422 million in three years from just $77 million in 1983, according to the research firm.

The breakup of AT&T Co. last January and an unbundling of the market for residential telephone handsets combined with the availability of semiconductor components enabled a rash of new entrants to participate in the market for telephone equipment. According to Dataquest statistics, this part of the market should grow at a compound annual rate of 31% to $4.4 billion by 1988 (from $1.1 billion in 1983) and become the largest segment of the communications equipment field.

The key telephone systems (KTS) segment was also greatly affected by the Bell dissolution. The breakup of AT&T into the seven Regional Operating Companies confused users, enabling non-Bell suppliers to penetrate the user community more than in previous years. This penetration probably will continue until AT&T recuperates from its surgery. Dataquest foresees that the market for this gear will increase from 1983's $2.4 billion to $2.6 billion by 1988.

The fastest-growing segment in the U.S market be that of the nascent voice/data work-station sector, Dataquest believes. This area will experience a compound annual growth rate of more than 108% between 1983 and 1988. Within three years, it will top $1.6 billion versus just $40 million two years ago, the research firm believes.

–Robert J. Kozma

U.S. COMMUNICATIONS INDUSTRY SELECTED MARKET ESTIMATES
(Millions of dollars)

Category	1983	1988	Compound Annual Growth Rate 1983–1988
Total	**$12,238**	**$25,527**	**15.8%**
Customer premises equipment	**6,820**	**13,430**	**14.5%**
Private branch exchanges	2,820	4,060	7.6%
Key telephone systems	2,360	2,600	2.0%
Residential telephones	1,140	4,350	30.6%
Facsimile machines	460	790	11.4%
Voice-and-data work stations	40	1,630	108.9%
Transmission equipment	**1,832**	**3,005**	**10.4%**
Multiplex	540	820	8.8%
Carrier	850	1,480	11.8%
Microwave radio	442	705	9.8%
Data communication equipment	**1,530**	**4,938**	**26.5%**
Stand-alone modems	788	1,592	15.1%
Multiplexers	209	919	34.5%
T-1 multiplexers	30	353	63.7%
Data PBXs	77	422	40.5%
Local-area networks	140	1,030	48.2%
Front-end processors	386	622	9.5%
Switching equipment			
Central office	1,925	2,408	4.6%
Cellular radio	**131**	**1,746**	**67.9%**
Base station	106	850	51.6%
Radio telephones	25	896	104.6%

SOURCE: DATAQUEST INC.

NTT MOVE MEANS STRONG GROWTH IN 1985

Industry executives and analysts in Tokyo, despite their fears about a slowdown in the U.S. economy, are predicting strong growth in Japan's market for communications equipment this year. "We see overall growth of 45% annually in the communications sector for the 1984 to 1986 period," reports analyst Bernard Key, who follows the industry in Tokyo for Jardine-Fleming (Securities) Ltd.

The fuel for this growth is coming from two sources. First, the recently completed Nippon Telegraph & Telephone Public Corp. optical-fiber trunk line that links all major Japanese cities will lower communication costs by an estimated 20% to 30% by offering increased speed and efficiency.

Because the average large Japanese company spends about $3 million each year on data-transmission costs, these savings will release funds that analyst Key predicts will be spent in building in-house communications systems such as multiplexers, exchanges, key telephones and video conferencing. This buildup, and a second stage—in which large firms build communication links with their major offices, customers, or banks—will last for the next five years.

None of this would be possible without the second factor—the liberalization of Japan's telecommunications laws under new legislation passed this month by the Diet, Japan's parliament, that will take effect this April 1. Companies prohibited from many forms of data transmission will now be able to forge these links.

In addition, the new telecommunications laws free customers from having to buy their primary telephone equipment from the monopolistic NTT, meaning that companies such as Matsushita Communication Industrial Co., Yokohama; Iwatsu Electric Co., Tokyo; Nitsuko Ltd., Kawasaki; and NEC Corp., Tokyo, will be competing fiercely for a share of the new market.

The market for telephone sales last year, estimated at $180 million, will nearly double to $340 million in 1985, estimates Koichi Iida, a supervisor in NEC's office of switching planning in Tokyo. As the market expands still further, to an estimated $530 million in 1987, Iida foresees that home telephone systems composed of multifunction units will account for about 30% of that growth. Stronger sales at home may only offset expected market losses in the U.S. market, where sales dropped in 1984 and are expected to deteriorate further this year in the wake of oversupply and falling unit prices. Nonetheless, anticipating the domestic boom, Fujitsu Ltd., Kawasaki, has decided to enter the home telephone market.

But this growth may not be profitable for many firms because of the large capital investments required to organize the telephone service and sales facilities. These were formerly the exclusive province of the NTT monopoly, which is being privatized as yet another part of the market liberalization.

Last year's 16% growth in the PBX equipment market to about $375 million will grow a further 6% to a total of 22% in 1985, say industry sources, who predict a takeoff in multifunction terminals combining voice and data. Sales in Japan of these products will be just $50 million this year. That figure is expected to double by 1987, when the total PBX market is expected to be worth more than $500 million.

One market category, large-capacity switches, will probably show almost no growth for 1985. The market for this equipment increased 32% in 1984 to a total of $670 million, but growth will slow to just 6% in 1985, according to Tomonobu Kato, general manager of NEC Corp.'s office of switching planning, because many of these big ticket items were installed last year as NTT completed the first phase of a long-term plan to build its version of an integrated all-digital nationwide communications system.

The facsimile market, always strong in Japan because of its convenience in transmitting Japanese-language materials compared to unwieldy word processing, grew 22% last year to an estimated market total of $836 million. This market will top $1 billion in 1985, as a new generation of facsimile machines (the G-4 category, which will increase transmission speeds fivefold, from 9.6 kb/s to a maximum of 48 kb/s) makes its debut in April.

The Japanese government, recognizing the long-term value of communication markets, is recommending special tax credits and other assistance to domestic firms to spur further growth. A recent report by the Telecommunications Council, an advisory body to the Ministry of Posts and Telecommunications, said the world market for electronic information transmission, valued at $92.2 billion in 1980, would grow to $258 billion by 1990 and to $547 billion by the year 2000. –**Michael Berger**

TABLE: JAPANESE COMMUNICATIONS-EQUIPMENT MARKET
(Millions of dollars)

Category	1983	1984	1985	1986
Total	**$1,680**	**$2,340**	**$3,370**	**$5,450**
Facsimile equipment	510	790	1,200	2,020
Exchanges	864	1,100	1,500	2,400
Telephones	102	141	196	287
Local-area networks	75	126	212	360
Optical fiber	133	188	267	381

SOURCE: JARDINE FLEMING SECURITIES LTD.; *ElectronicsWeek* ESTIMATES.
(CONVERSION RATE: 240 YEN = $1)

GOVERNMENT ACTIVITIES BRIGHTEN PROSPECTS

The signals in West Germany's communications markets point to a year of healthy growth. But rather than from the private and military sectors, the push will come from the Bundespost, the Federal Posts and Telecommunications Administration, the country's largest single customer of communications gear.

In 1985, the Bundespost will invest some $6.35 billion for hardware, 90% of that amount for telecommunications equipment alone. The 1985 expenditures will be a whopping 30% more than those of 1983. Much of the investment will go for expanding the country's conventional telecommunications infrastructure, but a large chunk will be for new projects—still on the drawing boards or in discussion—that will develop into big markets in the years ahead.

One is broadband cable networks for television distribution, a field in which West Germany has been lagging behind the U.S. and, particularly, its smaller neighbors, Switzerland, the Netherlands, and Belgium. By the end of 1984, some 3 million dwellings—about 13% of all households—had been hooked to regional cable networks. By the end of this decade, postal authorities say, roughly half of all European households will have cable TV.

TABLE: EUROPE'S TOP FIVE MARKETS FOR COMMUNICATIONS EQUIPMENT
(Billions of dollars)

Country	1984	1989
France	3.6	3.8
West Germany	3.0	3.5
U. K.	2.8	3.6
Italy	2.0	2.7
Spain	1.3	1.9
Total	**12.7**	**15.5**

SOURCE: ARTHUR D. LITTLE INC.

Another project that is sure to generate cash for communications houses in the future is the integrated services digital network (ISDN). This network, with its transmission speed of 64 kb/s, accommodates such services as telephone, teletex, telefax, textfax, data communications, videotex, and videophone. In 1985, the Bundespost will start ISDN pilot projects in Stuttgart and Mannheim, which will go into regular service in 1986. By 1988, the Bundespost will spend about $1.5 billion for ISDN projects. The agency figures that by the early 1990s, there will be between 4 million and 5 million ISDN subscribers.

Glass fiber technology, a subject of much discussion during the past decade, is now entering the big-market stage in West Germany. The first part of what the Bundespost calls a fiber optics "Kommunikationsautobahn" (a communications highway), the 100-mile leg from Hamburg to Hanover, was completed in late 1984. By 1987, this network will extend through the Ruhr area, Frankfurt, and Stuttgart to Nuremberg and Munich in southern Germany.

In addition, together with the country's communications industry, the Bundespost is installing glass-fiber-based local-area networks in seven major German cities, a project, to be completed by 1987, that is inducing the industry to develop new line and terminal equipment. The Bundespost believes some 1 million subscribers will be tied to glass fibers for communications by 1995.

Perhaps more than the evolution of the market, observers of the French scene this year will be watching to see whether Alcatel-Thomson, of Paris, the new national telecommunications monolith formed by the merger of CIT-Alcatel and the Communications Division of Thomson-CSF, can get its operation hitting on all cylinders. The firm is reportedly suffering growing pains caused by the redundancy and overcapacity that resulted from the merging of the two groups.

Still, there is little doubt that the company has the technological tools to put together a world-class product offering, and has the advantage of an aggressive domestic program by the French Direction Générale des Télécommunications (DGT) to underpin its efforts. The French communications equipment market will grow about 15% this year after a strong 17% rise in 1984.

This looks particularly good in light of a French gross domestic product that was almost flat last year because of the Socialist government's austerity program. According to the DGT, French telecom exports rose about 8% last year, although they are expected to pick up about 16% this year and continue at that rate for the rest of the decade. Most of those exports will probably be in optical fiber transmission and telematics services.

One good indicator of how French telecommunications markets will fare is the amount of investment the DGT is willing to put into a given area. This year, the top priorities will be projects in urban networks, switching and transmission which will cost $700 million, $600 million, and $550 million, respectively—about the same as was invested last year. The first and the third are favored areas in light of the DGT's project to take optical fibers directly into the homes of some 1 million families by the end of this year.

Britain's telecommunications sector, meanwhile, is feeling the stimulating effects of a newly aggressive British Telecom. Though shares in a newly privatized BT went on sale only in November, it has been operating more as a private company. This shows up in an ever-widening range of products and services. In the small private automated branch exchange sector for systems of less than 100 lines, for example, it now offers 11 different types of small modern PABXs. **–John Gosch**

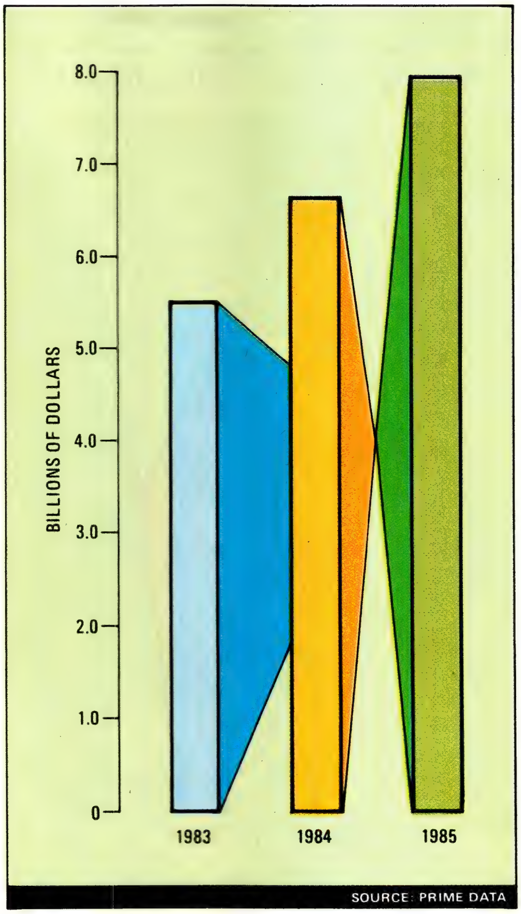
VLSI TEST GEAR WILL SUSTAIN GROWTH IN 1985

The test-and-measurement industry will likely face a test itself this year, a test that involves just one question: How much of the recent robust growth rate for the test-equipment market can be sustained if the overall electronics industry cools down?

Executives agree that some segments of the industry are resistant or react inversely to business-cycle downturns. Thus there is general confidence that the demand for very large-scale integration test equipment will grow this year, and sales of research and development instruments will likely increase if general production begins to taper off. But those increases may have to offset decreases in traditional test-and-measurement areas in the upcoming year to maintain 1984 growth rates.

Prime Data, a market research firm in San Jose, Calif., says the test-equipment-industry market in 1984 rose 20% to $6.7 billion. For this year, it expects 18% growth, to $7.9 billion. For the automated-test-equipment segment, which grew 28% last year to $1.7 billion, Prime Data predicts growth of 22% in 1985. But Alex d'Arbeloff, president of Teradyne Inc. in Boston, says the future will be difficult to predict until the current semiconductor slowdown turns out to be either an "inventory adjustment" or a harbinger of a recession.

"Nobody is sure," says d'Arbeloff. "We'll know more by February or March." If the economy were to slip into a recession, he says, "you get an immediate decrease [in orders] as people change their [buying] plans. And then they shift their buying from expanding their present lines to testing new products. We would expect a lot of interest—assuming it's a recession—not in expanding, but in buying our new products to test their new products."



SOURCE: PRIME DATA

Testy. The test-and-measurement equipment market in 1984 rose 20% to $6.7 billion from 1983's $5.6 billion, estimates Prime Data, and the market this year could grow another 18% to $7.9 billion.

Richard Allbright, director of marketing at Factron, a division of Schlumberger Ltd. in Latham, N.Y., (formerly Fairchild Camera and Instrument Corp.'s Manufacturing Test Systems Division), remains optimistic about the ATE market but says that some hesitancy has entered the market of late. "Companies seem to be pushing back [their buying] decisions." The personal computer makers are still expanding, he says, but not nearly as aggressively as they did at the beginning of last year, and the personal computer business has a direct impact on the test-equipment business.

Still, Allbright says other areas, such as surface-mounting technology and growing markets in the communications industry, will counterbalance the market enough to provide a 25% growth rate for ATE in 1985.

Russ Craig, director of strategic planning for GenRad Inc. of Concord, Mass., also expects VLSI to provide much of the new market for ATE products. To meet that demand, he says more manufacturers will be bringing testers to market, and "by late 1985, there will be a full set of VLSI state-of-the-art ATE products." Products related to the implementation of 32-bit microprocessors will also have increased demand, he says, because "32-bit microprocessors will be pulled through no matter what happens to the economy."

Rick Hill, marketing and sales manager for semiconductor test systems at Tektronix Inc. in Beaverton, Ore., offers a mixed forecast. "By June, the economy will take somewhat of a downturn, and our market trails about six months after that," says Hill, whose division's performance was up 25% to 30% in 1984 over 1983. "There will be a duplication of last year—not a substantial amount of growth."

Although forecasts of absolute performance vary, there appears widespread agreement that the ATE business will retain growth rates higher than the electronics industry as a whole. William R. Thurston, president of GenRad, says this is because of the current emphasis on quality and productivity, both of which will continue to provide markets for ATE. "I would expect ATE to be less affected by the business cycle at large," he says.

Growth in the microprocessor development market is moderate now, says Mark Tolliver, marketing manager for the Logic Systems Division of Tektronix, but he sees growth of 20% to 25% in 1985, which is consistent with industry-wide estimates. The market for these systems advanced 22% to $715 million last year, but estimates call for growth of 27% to $910 million in 1985 as the systems evolve into engineering work stations. –**Craig D. Rose**

BASIC DEMAND FUELS STRONG GROWTH

Despite a downturn in semiconductor prices and some oversupply problems, the strength in basic demand, plus Japanese manufacturers' commitments to capital investments through 1986, means firms in the Japanese test-and-measuring-equipment market are looking at another two to three years of strong growth. The marketplace, which totaled $290 million in 1983, will grow to $436 million in 1984 and $638 million in 1985, sources estimate.

"There's an amazing backlog of orders," says Peter G. Wolff, an electronics industry analyst for Prudential-Bache Japan's Tokyo office. "And now the Japanese test-and-measurement firms are stepping up exports." Wolff and others now see U.S. firms' edge in their home markets showing signs of erosion, despite software problems with Japanese testing devices that often make their operation overly complex.

Just five years ago, U.S. firms controlled more than 80% of the market in Japan for test and measuring equipment. Today, that share is down to about 50% in overall integrated-circuit testing, and less than that in memory devices.

Two companies, Takeda Riken Co. and Ando Electric Co., both of Tokyo, continue to show the strongest growth. Takeda Riken, owned by Fujitsu Ltd., Tokyo, is the market leader in memory test equipment with a 30% share and estimated 1984 sales of $50 million. Of Takeda Riken's estimated total 1984 sales of $110 million (which was up 56% from 1983), $40 million are in logic. Overall growth of 60% is forecast for this year, with a sales target of $230 million. In a move to broaden its operations, Takeda Riken aggressively sought U.S. customers in the past year, and is said to have gotten contracts with such companies as IBM Corp. and Motorola Inc.

Ando, 50% owned by NEC Corp., Tokyo, reported a 90% increase in sales for the first half of last year, and its revenues will have exceeded $120 million for 1984. This year, the company sees growth of 55% to $186 million, about evenly divided between memory and logic testers.

The market picture in logic testing is not as bleak for U.S. firms, although Fairchild's position has slipped to a still-dominant 41% share, a strong lead over Takeda Riken and Ando, which each have logic market shares of about 12% to 13%.

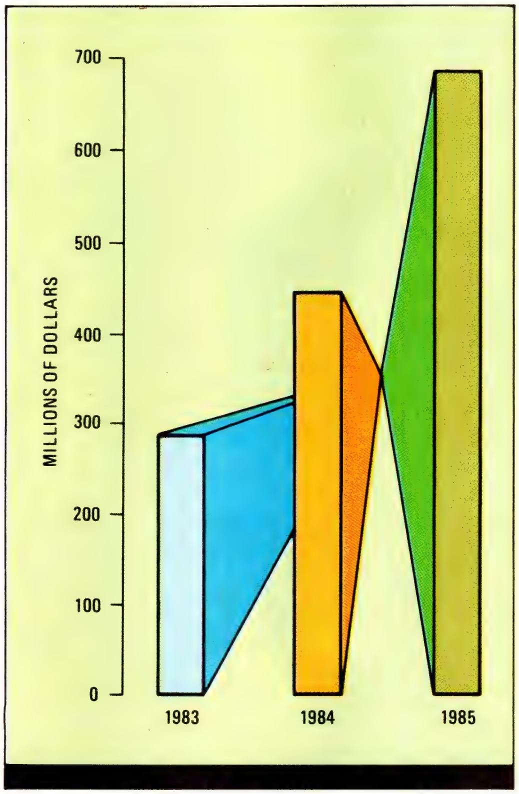
Another major Japanese strength is speed of operation. Whereas most U.S. models operate at 25 MHz, most Japanese are at 40 MHz, thus giving them superior speed and ability to cut chip-production costs.

Takeda Riken and Ando also dominate the measuring-instrument market in Japan, with 1984 sales of $50 million each, and growth to $60 million expected in 1985. Board testing is still dominated by the U.S. firm of GenRad Inc., Concord, Mass., which sells in Japan through Tokyo Electron Ltd., Tokyo, and racked up 1984 sales in Japan of $70 million. Takeda Riken recently announced a new 30-MHz memory tester that can simultaneously test 16 integrated circuits, double the capacity of its previous products. Ando's newest products are 20- and 40-MHz testers for microprocessors, gate arrays, and logic circuits.

Tokyo Electron has strengthened its links to GenRad and will market large-scale-integration testing equipment manufactured in Japan with improved software, which may make it a strong competitor to Takeda Riken and Ando. Tokyo Electron claims to have won a new contract order from Motorola, which opened another LSI plant this year, but real sales growth is not expected until late next year.

Optical-fiber testing is just developing, with Ando and Anritsu Electric Co. in Tokyo splitting total 1984 sales of $20 million. That figure is likely to double this year. The measuring-equipment segment is expected to grow 20% in 1985, says Robert Johnson, an analyst with W.I. Carr, Sons & Co. (Overseas) Ltd.'s office in Tokyo. The reason, he says, is the increasing development of optical-fiber-related systems.

Testers for electrically erasable programmable read-only memories might be an emerging market. "We think there's a niche for us," says Minoru Takagi, president of Nippon Megatest Ltd., a wholly owned subsidiary of Megatest Inc. in San Jose, Calif. "Many manufacturers still use dynamic RAM testing systems for EEPROMs, but they're no longer good enough. Devices are becoming so highly integrated that more complex technology is required for testing." –**Michael Berger**



Expanding. The Japanese market for test and measurement equipment is expected to increase to $638 million this year from last year's $436 million. The market in 1983 totaled $290 million.

GROWTH, THOUGH GOOD, TO SLOW FROM 1984

It's been a fantastic year, far better than expected." In a nutshell, that is how Bill Whitward, international marketing manager for test and measuring equipment at N.V. Philips, Eindhoven, the Netherlands, assesses the 1984 market for test and measurement systems. The Philips manager could be speaking for his counterparts in many other European countries, because most of them are also talking about good to booming business.

Whitward estimates the market rose about 20% in 1984, with Philips performing even better than that and gaining market share as well. Of course, the strong value of the U.S. dollar has helped make European products exported to dollar markets less expensive and imported equipment correspondingly more so.

But what has really driven the market are an improved investment climate, which has induced the industry to spend more for industrial equipment, and the entry of microprocessors into most fields. This in turn makes necessary more sophisticated test and measuring gear such as microprocessor development systems and automatic test equipment to "increase the efficiency of test procedures and thus to maintain a company's lead over its competitors," Whitward says.

Another push has come from the education sector. Governments, which had up until recently held tight reins on spending, laid out more money in 1984 for new equipment in retraining programs, trade schools, and universities.

As for 1985, "we are optimistic," Whitward declares. But he does not think that the performance of the test and measurement market this year will match last year's. "Even if 1985 shows a decline, it will still be a good year," he says. "I do not see customers substantially cutting back their purchase requirements."

Strong demand for test and measuring equipment has come virtually from all parts of the industry and is likely to remain strong this year. Instruments that have sold best include microprocessor development systems, digital oscilloscopes, and ATE. But there has also been good growth for digital voltmeters, counters, signal sources, and particularly for power supplies, Whitward says. "There is hardly a group of equipment that did not grow."

In terms of individual countries, after a phenomenal upswing in 1983, the UK market dropped somewhat in 1984, Whitward says. "Still, we are not dissatisfied, and for 1985 we are not pessimistic at all." The research and development sector in the UK performed much better, for example, than did the production, service, and educational sectors.

France performed well in 1984, Whitward says, which is one vindication of that country's heavy investment in high-technology fields. "Business there has been better than expected." In West Germany, the favorable investment climate, the economy's overall improvement, and, as in France, the activity in areas such as computers and communications, have all benefited the test-equipment market.

In general, Whitward reports, there has been good performance throughout the European Economic Community, as well as in Switzerland and Scandinavia. "And as for places other than Europe, we have done good business in Pacific basin countries such as Singapore and Indonesia," Whitward says. "If in most European countries and elsewhere, growth in 1985 won't quite be the same as in 1984, we are still optimistic about the year ahead."

The French test and measurement market, measured in francs, should expand next year by just under 10%, although domestic production is expected to rise by no more than 7%. Using volume of equipment as the yardstick, however, French-made test-gear production will fall in 1985 by about 1%.

The UK's instruments and test-equipment sector had a buoyant performance in 1984, and this year looks equally promising. "In general, business has been good both in instruments and ATE gear," points out Roy Lester, marketing manager at Marconi Instruments Ltd. in London. But growth in ATE, which has been running at between 60% to 70% per year, will slow in the year ahead, he maintains. This reflects both a tailing-off of the boom-business years and increasing competition as established manufacturers broaden their product lines and new competitors move in. **–John Gosch**

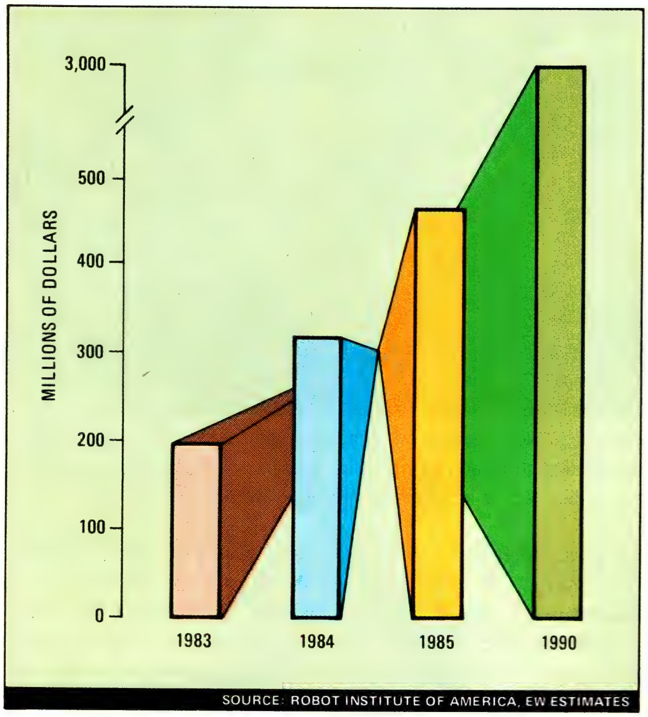
Demanding. The increased production and use of ICs and microprocessors has boosted the demand for more sophisticated test and measuring gear such as microprocessor development systems and automatic test equipment to increase the efficiency of test procedures.

ROBOT MAKERS SEE BIG GAINS IN 1985

Robot-system manufacturers didn't have a bad year in 1984, with growth throughout the industry up an average of more than 50% to about $300 million, according to the Robotic Industries Association in Dearborn, Mich. This year shows some signs of even stronger growth as new markets take advantage of the technology.

Traditional end users of robotics equipment—for applications such as spot welding, spray painting, and materials handling—remain the biggest customers. Of these applications, the first two will remain at their present technological level; no significant change is expected in the intelligence of the programs that control the robots or in the precision of the robot end effectors. There has been some movement toward incorporating direct-drive electric motors into arm-positioning gear, but research and development in this area doesn't represent a major shift for robot makers or suppliers of parts for robots, industry observers feel.

The stasis in the older robot markets is not due to manufacturers' reluctance to upgrade their products; rather, users apparently are satisfied with the ones they already have. "We could easily develop positioning systems for automatic spot welding that are more precise than what we're selling now. But why should we spend the R&D bucks for something our customers won't pay a premium for?" says Peter Planchock, national sales manager at GMF Robotics Corp. in Troy, Mich.



SOURCE: ROBOT INSTITUTE OF AMERICA, EW ESTIMATES

Booming. The market in the U.S. for industrial robots grew approximately 50% in 1984 to about $300 million, according to the Robot Institute of America, and should grow by an even greater rate this year. By 1990, the market could reach $3 billion.

Materials handling, however, is a different story. In that part of the business, a newer robotics market than heavy industry, everyone wants to get into the act, and no improvement is unwelcome. Although industry analysts discuss the possibility of an eventual industry shakeout, none is expected in 1985—mostly because improvements in machine vision and computer control of materials flow have evolved so that the electronics industry can now put robots to work in component assembly.

Planchock sees "tremendous promise" in the automated manufacture of four electronic product categories: rigid media and disk drives; automated test equipment; wafer fabrication; and surface-mounted devices. All told, robots that assemble electronic products will account for about 30% of GMF's $100 million in projected sales for 1985—a remarkable figure for a company so strongly associated with automotive assembly. "But we know we're on the right track," says Planchock, "because with the same market focus [as last year], we were the only robot manufacturer to show a profit in 1984."

No RIA statistics have been compiled for the electronics industry. But industry-wide orders for electronics-assembly robots increased a whopping 150% over 1983, says David Banks, executive vice president for business development at Object Recognition Systems Inc. in New York. Still, companies in a new industry often must wait a few years before the bottom line shows black ink. "GMF simply had the right product mix at the right time," explains Planchock.

The No. 2 robot maker, Cincinnati Milacron Inc. of Lebanon, Ohio, expects orders in the $50 million range for 1985—enough, or nearly enough, to make its robotics division profitable, too. The firm is not seeking a mix of robotic applications, however, but plans to maintain its heavy industrial emphasis.

The automotive industry will retain the lion's share of the robot market in 1985 with about 35% of all robots at work in auto plants, according to Donald Smith, director of industrial development at the University of Michigan, Ann Arbor. But that share should dwindle to about 24% by 1990, he says.

The industry consensus is that the electronics industry is the hot area for growth. It's starting from a baseline near zero, and is expected to grow to 18% of a $3 billion market by the end of the decade. Many of the newer companies hope to jump quickly into the big leagues by selling their machines to electronics manufacturers. Indeed, unfilled orders for electronics-assembly robots totaled nearly $65 million at the close of 1984.

"It's a virtually untapped market," says Philip Monnin, the marketing vice president for Adept Technology Inc., in Sunnyvale, Calif. "Digital Equipment Corp., Honeywell, and Motorola [all recent Adept customers] knew they wanted to automate, but they hadn't considered it feasible because of the inherent complexity of their products."

–**David M. Weber**

GOOD GROWTH IN 1985 TO TAPER OFF SOON

Though the market for industrial robots in Japan will grow about 30% to $125 million this year from about $100 million in 1984, overall growth from the period of 1985 to 1990 may slow to around 15% annually unless important new technologies in the areas of machine vision and touch sensing are refined, predicts the Japanese Industrial Robot Association in Tokyo. "Ultimately, the robot is meant to replace the worker," says an official with the JIRA. "The ability to develop vision and touch-sensing functions in the next two to three years will make or break the demand for robots in Japan." Industry leaders, he reports, are confident that already existing technologies can be refined in time.

Matushita Electric Industrial Co., Osaka, continues to hold a commanding lead in the Japanese industrial robot market, a market that is becoming increasingly crowded and plagued by dangerously narrow profit margins. Component-insertion robots account for more than two thirds of Matsushita's sales. Like most of its Japanese competitors, Matsushita, the world's largest manufacturer of consumer electronics equipment, first developed the robots it markets for in-house use.

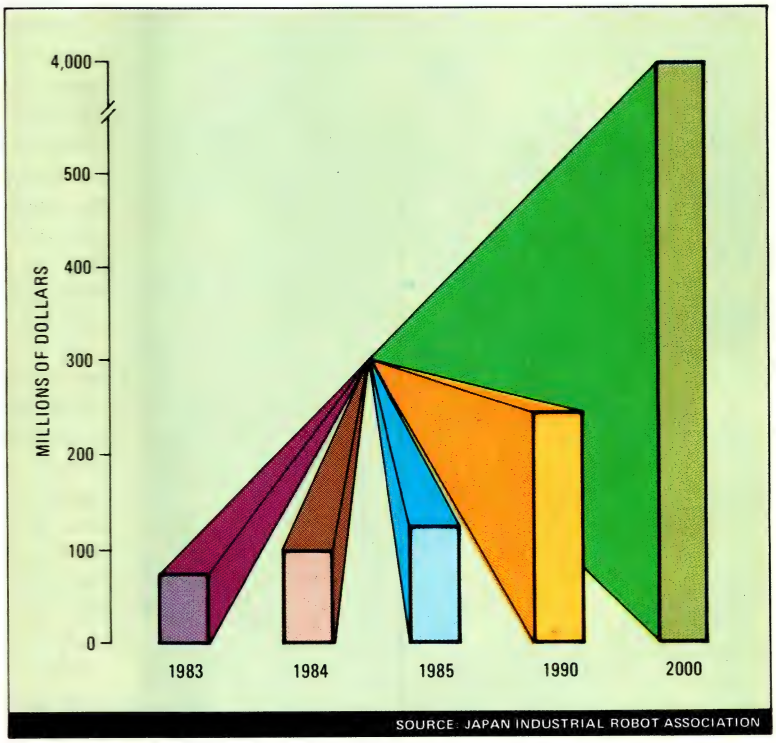
The consumer electronics giant posted robot sales of $152 million last year, which was not only 36% higher than the year before but also surpassed the combined sales of its four closest competitors. Fanuc, Hitachi, and Kawasaki Heavy Industries tied for second place with sales of about $35 million each, while Yaskawa Electric Manufacturing Co. in Kita-Kyushu came in a close third with $33 million in sales last year, estimates the investment company Prudential Bache, Japan Inc.

More than 70 producers now crowd the Japanese industrial robot market, forcing net profit margins in the industry below 5%. Still, low profit margins and dominance by a handful of giant manufacturers have not discouraged other major electronics companies from entering the competition. Last October, Sony Corp., Tokyo, revealed its plans to market a 16-bit computer-controlled production robot this spring. And Cincinnati Milacron (Japan) Ltd. in Tokyo started marketing industrial robots in December.

"Everybody and his dog seems to be making a robot of some sort," points out Tony Moyer, an industry analyst with the securities company W.I. Carr & Sons (Overseas) Ltd. in Tokyo. As in the U.S. market, a shakeout in the Japanese industrial robot market is imminent, and already there are signs that some major producers are cutting back. Kawasaki Heavy Industries Ltd., in Kobe, recently was forced to scrap the hydraulic system used on its spot-welding industrial robots for the more popular electric system. The midstream switch cost Kawasaki its lead in the spot-welding segment of the total robot market.

Still, some observers say that the robotics manufacturers to watch are not the assembly-oriented producers but rather those that are concentrating on systems integration. "The real meat of the robot is the control system," claims Peter Wolff, an analyst with Prudential-Bache. One such company is Dainichi Kiko Co. in the Yamanashi Prefecture, which enjoyed a growth rate of over 50% last year and may soon leapfrog to the fifth or fourth position in the Japanese industrial robot market. However, other market analysts in Japan are not so sure. According to these analysts, few Japanese robotics industry leaders take the young upstart competitor seriously: 60% of Dainichi Kiko's sales are overseas and it can do little more than exploit a limited custom-applications niche in the home market.

While manufacturers continue to cut prices in the slugfest that is taking place in the robotics market, producers of numerical tool controls, especially the industry leader, Fanuc Ltd., Tokyo, are finally enjoying robust sales and healthy profits after several very lean years. Orders for these products in the first half of 1984 increased 40% compared with the same period in 1983, the low point in the recent industry recession. When the final tally is completed, total sales for all of last year could reach as high as $2.5 billion, sources believe. **–Jonathan Joseph**



SOURCE: JAPAN INDUSTRIAL ROBOT ASSOCIATION

Lucrative. The market for industrial robots in Japan will grow about 30% to $125 million this year from about $100 million in 1984, predicts the Japanese Industrial Robot Association in Tokyo. By the year 2000, the market will exceed $4 billion.

AUTOMATION PROJECTS TO SPARK MARKET

After a relatively poor performance in 1983, makers of industrial electronic equipment in France, particularly numerical-control and automation systems, picked up sales last year as a result of the Socialist government's investment program aimed at modernizing French industry.

Domestic consumption in the sector rose by approximately 16% last year and will increase this year at a rate of about 17%. Particularly good news for French manufacturers such as Télémechanique, the Alsthom Division of the Compagnie Générale d'Electricité, and Merlin Gérin is that while exports of industrial electronic equipment should be up by about one point to 18.5% this year, imports are expected to remain flat.

Most industry observers, however, expect to see a massive marketing effort by U.S. and Japanese manufacturers (who up to now have been almost absent from the European market) between this year and the end of the decade. Consequently, domestic production should increase by about 18% from its current level of approximately $500 million, though that rate of growth is expected to slow to around 15% in 1989.

Driving the French market are continuing efforts by chemical producers and automobile manufacturers to automate their operations, though the highest growth rates are coming from the severely underautomated mechanical, agricultural, and food-processing industries: All have been receiving massive government support.

Leaps and bounds. Industrial electronics is a growth industry in many European countries, with the market for robot controls, such as this one made by Siemens AG, expanding rapidly. The industrial-robot market could expand by a factor of 25 in the next 10 years.

At the beginning of last year, the British Robot Association estimated that the world population of industrial robots had reached around 37,500 units, of which Japan had the lead with 16,500, followed by Europe with 12,500 and the U.S. with 8,000. Within Europe, West Germany is a clear leader with 4,800 robots, followed by Sweden at 1,900, Italy at 1,800, the UK at 1,753, and France at 1,500. Industry experts predict the industrial robot market will expand during the next 10 years by a factor of up to 25.

Even if the use of robots increases as predicted—some forecasters project that there will be about 40,000 robots in service by 1990—this would still affect only a few tenths of 1% of all employees in the industrialized countries, industry sources estimate.

As for 1984, Unimation Ltd. in Telford, West Midlands, UK, still probably the market leader, reports an excellent performance for the year and sees a bumper year in 1985. Unimation is charting a 30% compound growth rate for the next three years. The reason for its confidence, the company says, is that customers are showing a greater awareness of robotics in general, targeting the right applications with the right systems—in Unimation's case, handling and systems.

In West Germany, the industrial electronics equipment sector is a growth market, given the country's high wage costs and high degree of industrialization. In 1982, according to Siemens AG, Munich, a heavyweight in the field, the world market for electrical equipment for plant automation amounted to almost $8 billion. Since then, the market has risen sharply. The worldwide market for electrical and electronics equipment needed for automating the processes involved in producing cement, paper, steel, and other materials was around $5 billion in 1982 and has increased by about 3% annually since then.

The automated manufacturing sector is also experiencing strong expansion. An important part of automobile production, for example, consists of taking from various production lines and storage areas such items as the correct engine, fog lights, and oil cooler, and bringing them together for a particular vehicle on the assembly line. In this sector of automobile-production automation, the world market for the electrical parts alone now amounts to well over $2 billion. A growth rate of better than 20% is expected in the coming years, sources estimate.

The world market for all types of programmable controls totaled about $1.4 billion in 1982, Siemens says, and it will continue to expand at 20% a year. In that year, 45% of Japan's machines were equipped with programmable numerical controls; in Europe, the percentage had only just reached 20%. –**Robert T. Gallagher**

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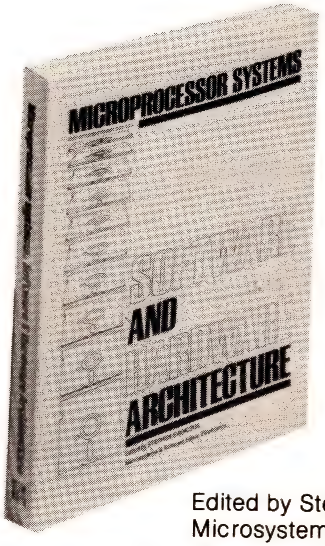

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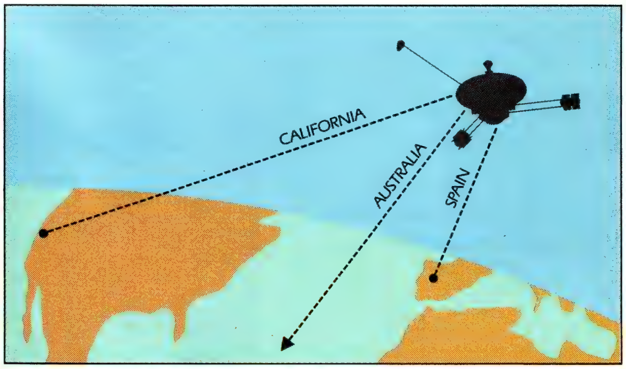

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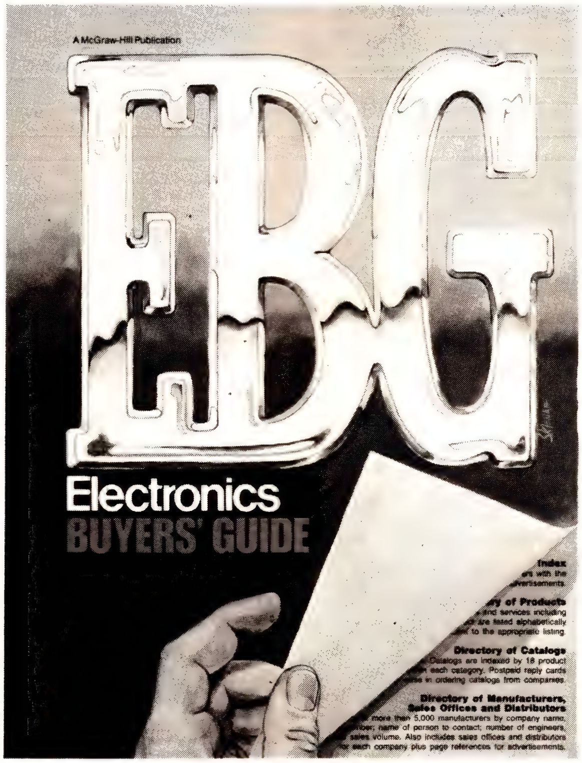
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MOS MEETS RADIATION CHALLENGE

New-generation MOS chips have geometries and processing techniques that stand up to X and gamma rays

☐ *by Carl Gusert and Kenneth A. Marks*

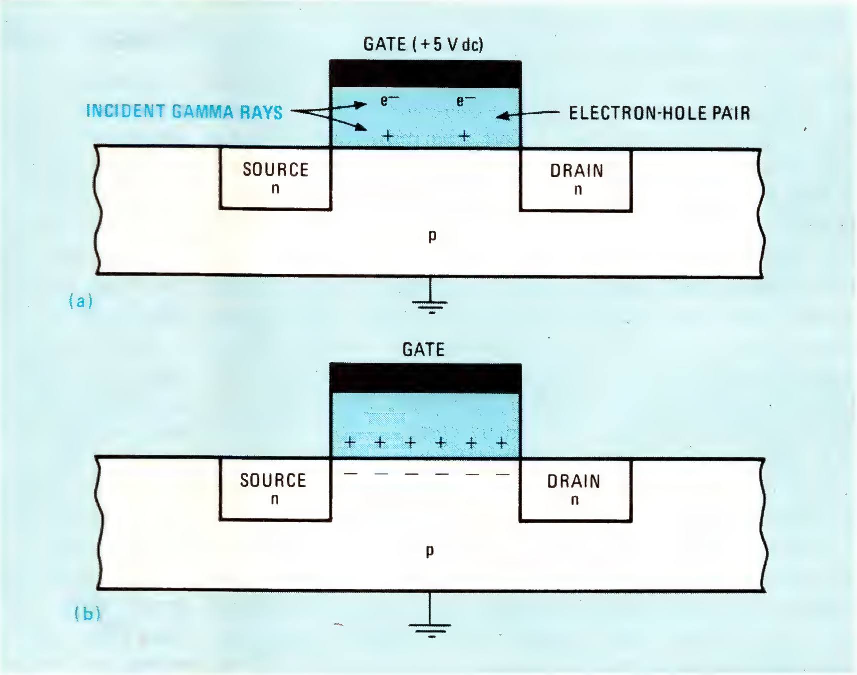
Until recently, systems requiring radiation-hardened integrated circuits were limited to bipolar or exotic and expensive semiconductor technologies. MOS parts, plagued with high levels of total-gamma-dose failures, couldn't be used in military or space systems. However, new processing techniques, geometries, and materials used in recent MOS and CMOS designs to increase performance and chip densities have increased these parts' radiation tolerance. For example, a reduction in gate-oxide thickness significantly improves the total-radiation-dose hardness of MOS circuits.

The damaging effects of radiation on bipolar and MOS parts depend on the type of radiation (neutron or ionizing) and whether the dosage is in the form of a sharp transient pulse or extends over a relatively long time. A major cause of degradation in bipolar parts is neutron radiation, which decreases minority-carrier lifetime and current gain; ionizing radiation has the effect of increasing leakage current. Because MOS parts involve majority carriers, as opposed to minority-carrier bipolars, they are relatively insensitive to neutron radiation. However, bulk MOS parts, because of their relatively large p-n junction volume, are sensitive to transient-ionizing radiation, while CMOS circuits are relatively insensitive because of their significantly smaller junction volume.

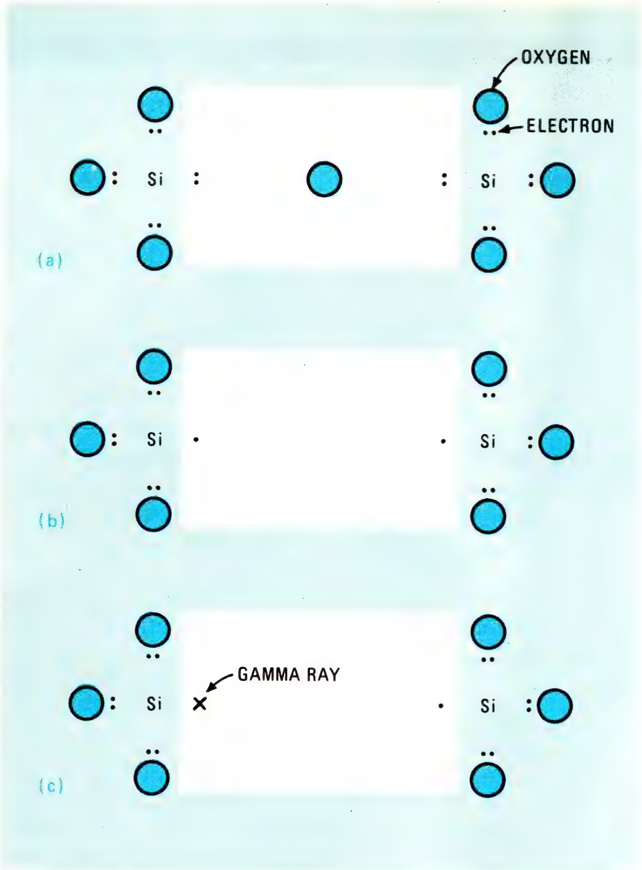
The two critical radiation environments are those found in the vicinity of nuclear explosions and in near-Earth space. The nuclear-blast environment is a function of several factors, the most important of which include the weapon type, yield, distance from the burst, and altitude of detonation.

Approximately 75% of the energy released in a nuclear explosion is in the form of X rays. Within the Earth's atmosphere, X rays are strongly absorbed and lead to the formation of a highly ionized region around the weapon. From this ionized region, in conjunction with the expanding mass of bomb debris, the shock wave develops. As the altitude of detonation is increased, the X-ray absorption in the atmosphere is distributed over a larger area due to the decrease in density of the air. The X rays are emitted when electrons fall into unfilled orbits of an atom, and they typically possess an energy of 4 to 5 keV.

Gamma radiation is shortwave electromagnetic energy that originates from the fragments of heavy atoms split in a nuclear detonation. The time sequence of gamma radiation from a nuclear blast typically consists of a peak within nanoseconds of detonation, trailing off over a 20-



1. Radiation damage. Radiation ionizes atoms in the gate oxide, creating electron-hole pairs (a). Because of the attraction of trapped positive charges, a negatively charged layer forms. This results in a threshold voltage shift of the transistor (b).



2. The hole trap. As shown in the two-dimensional view of the silicon dioxide structure (a), missing oxygen leaves one nonbonding valence electron for each silicon atom (b). A drifting hole annihilates an electron, leaving the parent silicon atom with a net positive charge (c).

to 30-ns period. Because of their high energy (greater than 1 MeV), gamma rays are very penetrating and therefore difficult to shield against.

Also very penetrating and difficult to shield against are the neutrons released by both fission and fusion reactions in nuclear explosions. Traveling somewhat more slowly than gamma rays, neutrons arrive as a pulse shortly after the arrival of gamma radiation.

Space presents a different threat to integrated circuits, in the form of charged particles. Galactic cosmic rays, ions from solar flares, and charged particles trapped in the radiation belts are all potential sources of single-event upsets—that is, a change in the logic state of a digital circuit that results from the passage of a single high-energy particle through a portion of that circuit. Such an upset occurs when the particle transfers energy to the silicon through ionization, creating electron-hole pairs. If this charge is generated in a depletion region of a semiconductor device, it may be collected and result in a false electrical signal, causing a change of state.

The rate at which transient-ionizing radiation arrives at a point is measured in units of rad(Si)/s, where 1 rad(Si) is the amount of radiation that deposits 100 ergs in 1 g of silicon. The integral of all ionizing radiation accumulated by a part is known as total dose and is measured in units of rad(Si).

The transient-ionizing radiation produces photocurrents in semiconductor junctions, which may result in latchup of CMOS devices, device burnout, data upset, or data loss, depending upon the device and its application within the circuit. Transient-radiation pulses that do not result in burnout or latchup generally do not result in any appreciable permanent change in MOS part characteristics.

The accumulated total dose received by a MOS part can cause large, permanent changes in their electrical characteristics, due primarily to the buildup of a trapped positive charge in the gate-oxide insulator and to the creation of interface states at the interface of the silicon and silicon dioxide. The trapped positive charge in the gate oxide causes a negative shift in the threshold voltage for both n- and p-channel devices, eventually leading to circuit malfunction. A buildup of interface states at the oxide-silicon interface will cause a degradation in transconductance in MOS transistors,[1] along with contributing to the radiation-induced shift of the threshold voltage.

A large neutron fluence—the total time-integrated number of particles that cross a plane-unit area from either side, expressed in particles per cm^2—may produce permanent displacement in the crystal structure of semiconductors. The collision of a neutron with the nucleus of a silicon atom can result in displacement of the nucleus from its normal position in the lattice, leading to the formation of interstitials (a lattice atom that has been transferred to a neighboring interstice, leaving behind a lattice vacancy) and vacancies.

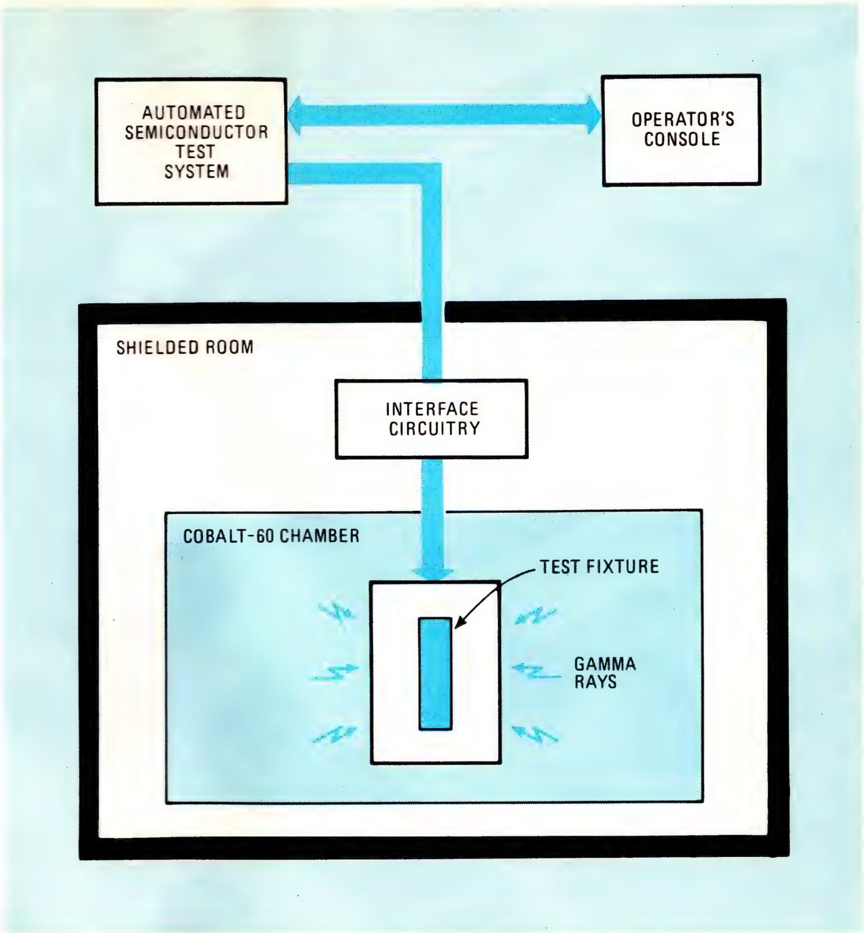
These interstitials and vacancies may, if sufficiently abundant, cause permanent changes in the electrical characteristics of the bulk silicon. In general, semiconductor devices will not be affected by neutron exposure levels less than 10^{10} neutrons/s. At this dose level, bipolar transistors will experience gain (h_{fe}) degradation, while MOS devices would be unaffected until reaching exposure levels several orders of magnitude higher.

Charge trapping

It is generally agreed that ionizing radiation produces electron-hole pairs in the silicon-dioxide film of a MOS structure. Under the influence of an applied field in the oxide, the electrons and holes that escape early recombination will drift to the metal-oxide or silicon-oxide interfaces. The electrons typically will escape from the system through the gate electrode, while a large percentage of the holes will interact with hole traps (Fig. 1) at the silicon-silicon dioxide interface.[2]

The hole traps are concentrated within a few hundred angstroms of the silicon interface, regardless of the total oxide thickness,[3] with the defect responsible for the hole trap related to excess silicon present near the silicon-oxide interface.[4] This excess silicon is always present in thermally grown oxides in high concentration near the interface as a result of the silicon dioxide growth mechanism.

The excess silicon is equivalent to a "missing oxygen atom" (Fig. 2a). In the complete silicon dioxide structure (Fig. 2b), each oxygen atom contributes six electrons and is located between two silicon atoms. The silicon atoms each contibute four outer electrons to the oxide structure. In Fig. 2b, the silicon dioxide structure with a missing oxygen atom results in each silicon atom



3. Test setup. Ten MOS devices were individually irradiated in a Cobalt-60 chamber while being monitored for functional failure by an automated test system. Two test patterns were repetitively written and verified until failures were detected.

having an extra, nonbonding valence electron. When a drifting hole combines with—and annihilates—either of these nonbonding electrons, the parent silicon atom is left with only three valence electrons, instead of the original four, resulting in a trapped positive charge (Fig. 2c).

The transport of radiation-induced holes to the silicon dioxide interface of a MOS device will result in the formation of interface states. The interface-state generation process is complex and time-dependent, involving two separate stages.[5]

The first stage determines the final value of interface states and occurs during the time required for radiation-generated holes to arrive at the interface under an applied positive bias. The second stage, beginning after the holes have reached the interface, determines the time scale for the buildup of interface states. The first stage occurs in less than 1 second, while the second stage may continue for thousands of seconds at room temperature.

Several similar models have been suggested for the interface-state generation. F.B. McLean[6] has suggested that radiation-induced holes, while transporting through the silicon dioxide dielectric, will break silicon-hydrogen bonds. The hydrogen ions would then drift to the oxide silicon interface under the applied bias, completing the first stage.

The second stage of interface-state buildup involves the hydrogen ions interacting with either Si-H bonds or Si-OH bonds at the interface, forming H_2 or H_2O_2, respectively, but in both cases leaving a dangling silicon bond. The remaining silicon bond is the source of the interface state.

Test results

Intel's latest scaled-down, advanced-MOS technology—called high-performance MOS, which uses ultrathin gate oxides, low processing temperatures, and several proprietary processing techniques—has resulted in very promising total-dose-radiation tolerance, based on test results for the 2148B 1-K-by-4-bit static random-access memory (Fig. 3). Five 2148B devices from each of two lots, one in a commercial plastic package and one in a military ceramic package, were tested at the Boeing Radiation Effects Laboratory. The devices were irradiated in a Cobalt-60 chamber, which provided uniform gamma radiation in a cylindrical test chamber. Devices were individually irradiated while being monitored for functions failure by the automated test system. While the test device was in the gamma environment, two test patterns, a checkerboard and its inverse, were repetitively written and then verified until the device failed to operate correctly.

Functional failure levels for all devices were in excess of $1\mathrm{x}10^5$ rad(Si), or approximately an order of magnitude greater than for older, nonhardened MOS technologies. Three of the 10 devices were still functional at 3×10^5 rad(Si). Both the 2148B and the 2147B 4-K-by-1-bit SRAM are currently produced on Intel's HMOS III. Intel's military 8086, 80186, and 80286 family of microprocessors will soon be available in HMOS III processes, along with several highly integrated communication and peripheral devices. ☐

Carl Gusert is the military products line manager at Intel Corp.'s Phoenix Division, and Kenneth A. Marks is an engineer at Boeing Aerospace Co.'s Radiation Effects Laboratory in Seattle.

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4. W.C. Johnson, "Mechanisms of charge build-up in MOS insulators," IEEE Trans., *Nuclear Sci.*, NS-22, No. 6, 2144.
5. P. Winokur, H. Boesch, J. McCarrity, and F. McLean, "Two-stage process for build-up of radiation-induced interface states," *J. Appl. Phys.*, 50 (5), 3492 (1979).
6. F.B. McLean, "A framework for understanding radiation-induced interface states in Si-O MOS structures," IEEE Trans., *Nuclear Sci.*, NS-27, No. 6, 1651 (1980).

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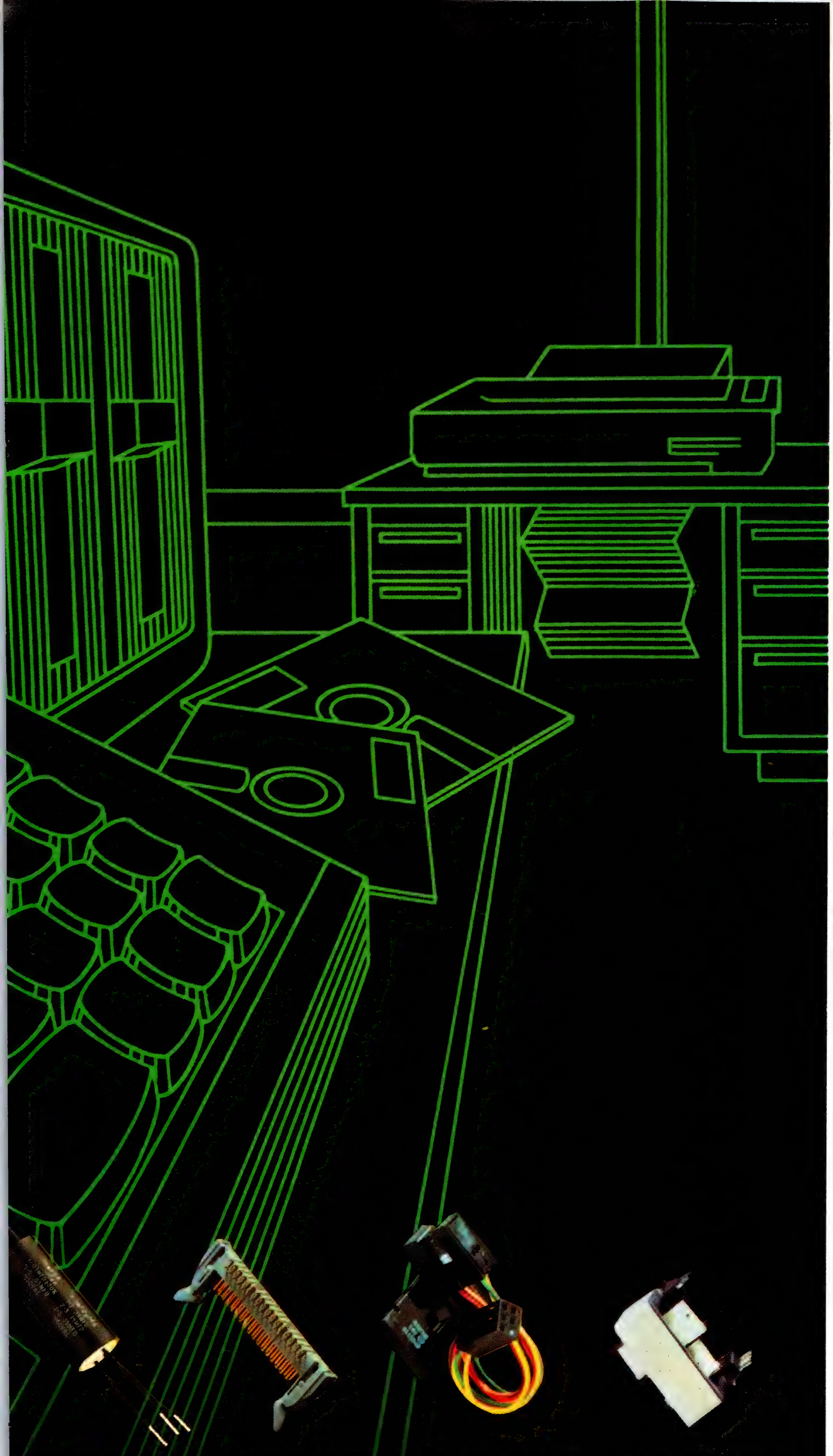

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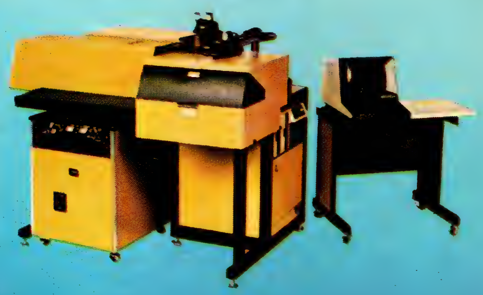

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DOMINO-LIKE MODULES BUILD COMPUTERS

Data-acquisition and modem-interface modules are added to a family of parts that stack on top of each other

by Steve Zollo

Joining National Semiconductor Corp.'s Macrocomponent family are a data-acquisition module and an intelligent telecommunications-interface module. The Macrocomponents are high-speed CMOS system-level modules, approximately two thirds the size of an audio cassette, each housing a self-contained subsystem that requires no external components. The modules can be plugged together, like cards in a box, in any combination to make up a complete system that uses no card cages, backplanes, cooling fans, or large power supplies.

The MA2103 Intelligent Telecommunications Interface is a Bell 103-compatible full-duplex telecommunication system. It provides a 300-baud, bidirectional serial interface for data communications over telephone lines and other narrow-bandwidth channels. The device incorporates a data-access arrangement for direct connection to the telephone line through a standard RJ-11-C connector.

"The MA2103 saves design time, shortens the customer's time to market, and is easy to integrate to any microprocessor-based system," says P.S. Kohli, product marketing engineer for hybrid system products. Operating-mode options consist of automatic or manual dial, auto answer, auto originate, telephone-number memory (in electrically erasable programmable read-only memory) and tone or pulse dialing. The part's power requirement is just 150 mW. The MA2103 interface is housed in the same 52-pin package, measuring 3.6 by 1.6 by 0.5 in., as the other modules in the MA2000 Macrocomponent family.

The MA2400 data acquisition Macrocomponent delivers 14 single-ended input channels with 12-bit (plus sign) resolution. The internal variable gain amplifier will handle signal levels from ±40 mV to ±5 V full scale. A software-controlled low-power standby mode is available as well as software-selectable gains of ±1 to ±128 in binary steps. The MA2400 delivers 1-ppm temperature-controlled voltage reference with an externally powered heater. This assures accuracy over a temperature range of –25° to +85°C. On-board firmware contains calibration data and routines that result in accuracy to within 0.05%. In lots of 100, the MA2103 sells for $220 and the MA2400 goes for $400. Both are available now.

The Macrocomponents combine National's NSC800 double-polysilicon CMOS family and 74HC logic components with its module capability, providing a way for systems designers to build computers for applications in which speed, power consumption, and space are critical concerns. All of the modules are plug-compatible—with 52 pins on the bottom and a 52-pin socket built into the top—and employ a bus structure that is a decoded ver-

sion of the NSC800 bus.

Besides the two new parts, the family consists of the MA2106, a 16-K-byte random-access memory module, the MA2800 central processing unit, the MA2232 RS-232-C serial input/output module, and the MA2732 8-K-byte EPROM module. A complete system including 64-K bytes of RAM, 8-K bytes of EPROM, the CPU, and an RS-232-C module would measure only 3.3 by 1.6 by 3.2 in. and consume less than 100 mA.

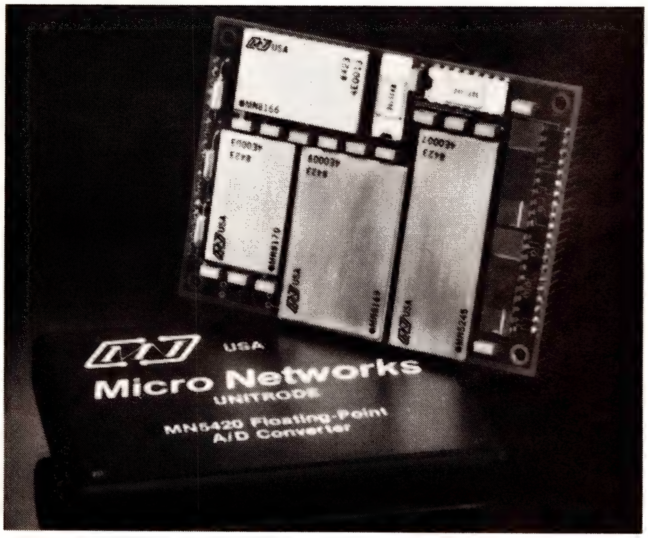
National Semiconductor Corp., 2900 Semiconductor Dr., Santa Clara, Calif. 95050.
Phone (408) 721-6233 [Circle reader service number 338]

Floating-point ADC produces 16-bit data stream

Designed for high-speed analog-to-digital conversion in radar, sonar, medical imaging, spectrum analysis, and other digital-signal-processing applications, the model MN5420, a floating-point a-d converter, produces a 16-bit data stream—4 bits of exponent and 12 bits of mantissa—at a rate of 320 kHz (3.1 µs). It can digitize signals as large as 10 V or as small as 10 µV for a 120-dB dynamic range. The MN5420 uses autoranging hardware to scale itself instantly over nine input-voltage ranges, achieving a 20-bit dynamic range.

The hybrid converter employs analog sampling, autozeroing, and a-d conversion techniques to achieve the 320-kHz sampling rate. The last function block in the analog signal path is a 1-µs 12-bit ADC, which is preceded by a track-hold amplifier and a programmable-gain amplifier that has nine gain ranges from 1 to 256. The gain of the amplifier is controlled by a 4-bit digital word, and at any time, the selected gain is such that the largest possible signal is presented to the 12-bit ADC. When the input is small, the amplifier gain is high; when the signal is large, the gain is low. For example, for input signals smaller than ±19.5 mV, the amplifier gain will be 256.

The model MN5420 consists of four thin-film hybrid packages on a small printed-circuit card with other integrated circuits. The entire circuit is mounted in a 3-by-4-by-½-in. shielded aluminum shell and potted with a thermally conductive compound. The model MN5420 sells for $1,295 for one to nine pieces, and small quantities for evaluation are available from stock. Military units will be available in about four months.



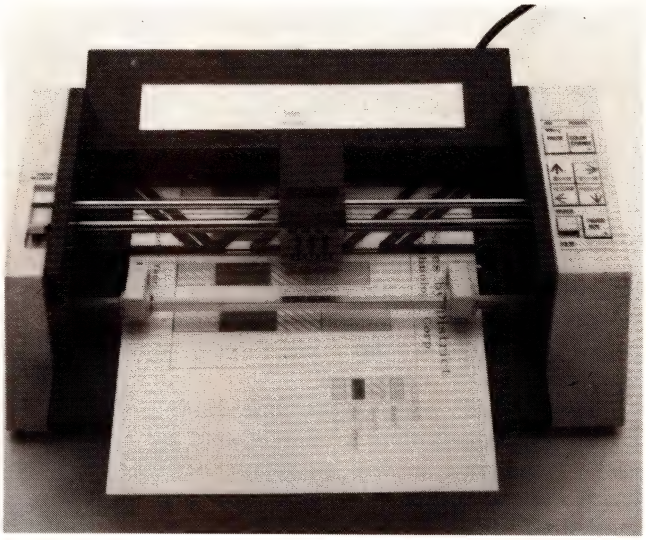
Micro Networks, 324 Clark St., Worcester, Mass. 01606.
Phone (617) 852-5400 Circle 364]

Four-color pen plotter moves at 112 mm/s

The Britewriter four-color pen plotter is compatible with three Hewlett-Packard Co. plotters and can be used with most major software programs. It is available with felt-tip pens in black, blue, green, and red. Optional colors include violet, orange, brown, and pink.

Pens can be changed without interrupting a job, and the Britewriter delivers full-color printing directly onto transparencies. Projected mean time between failures is 4,000 h, based on an 18% duty cycle.

The plotter operates at 60 mm/s in low-speed mode and up to 112 mm/s in high-speed mode. Plotting speed is 4.6 c/s in monochrome and 2.6 c/s in four colors. Plotting direction is along the horizontal axis, with accuracy to within 0.1 mm in both horizontal and vertical directions. Also included are 256-K of character and instruction storage and serial and parallel interface.



Compatible with most popular software packages, the Britewriter will be available this month and will sell for $599. Volume discounts will also be available.

NEC Information System Inc., 1414 Massachusetts Ave., Boxborough, Mass. 01719. Phone (617) 264-8000 [Circle 365]

Minicomputer maker unveils 68000-based Unix system

Making a serious commitment to microprocessor-based products, minicomputer maker Perkin-Elmer is introducing the 7350A, a 68000-based supermicrocomputer that runs the AT&T Bell Laboratories Unix System III oper-

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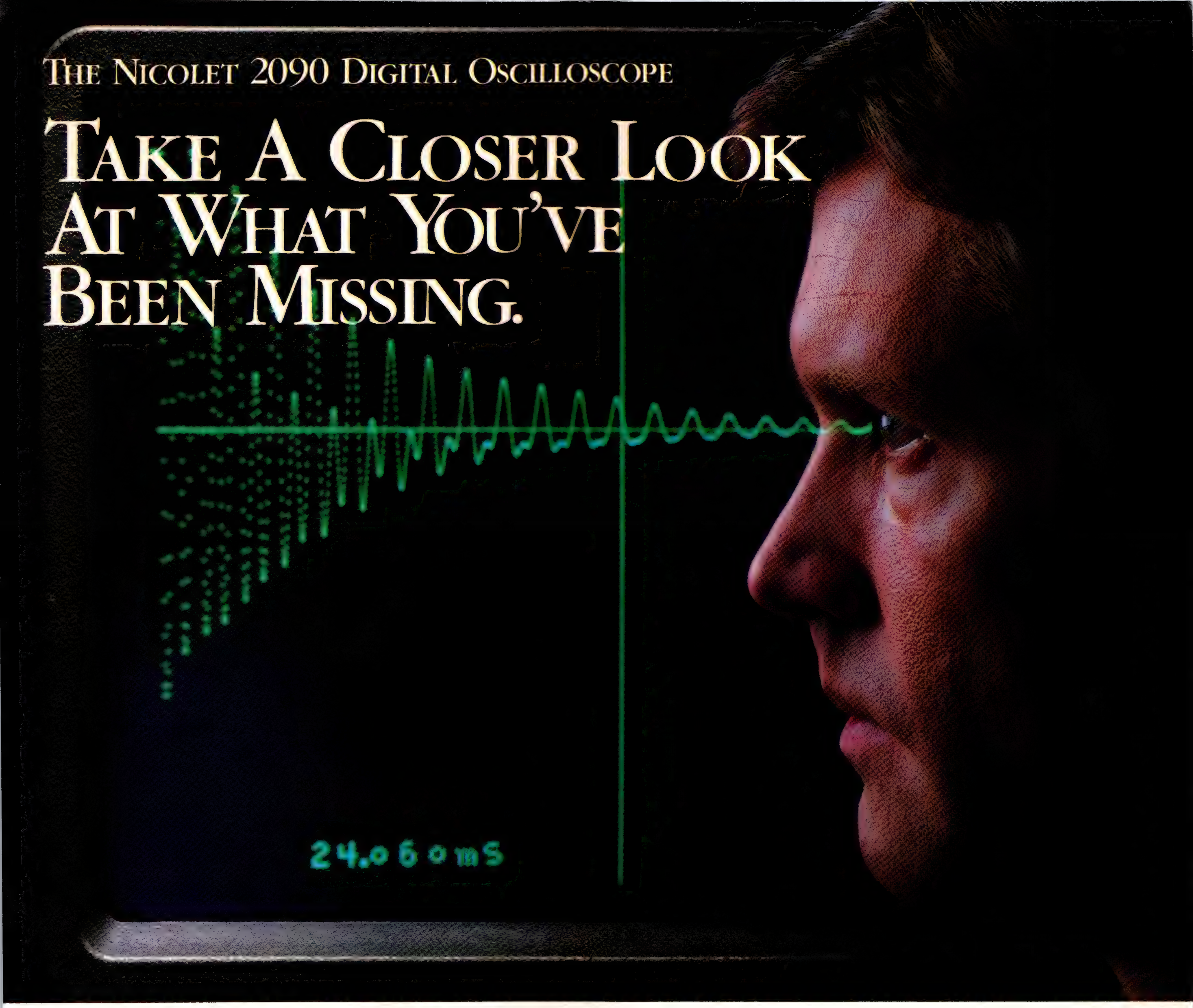

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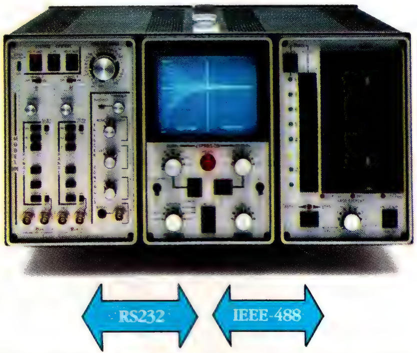

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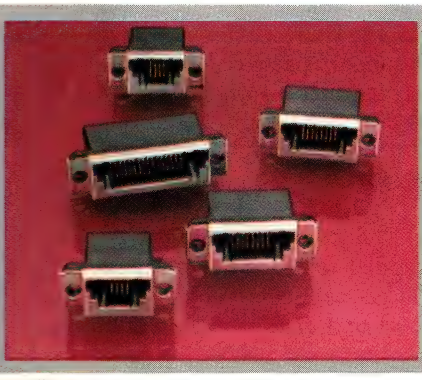

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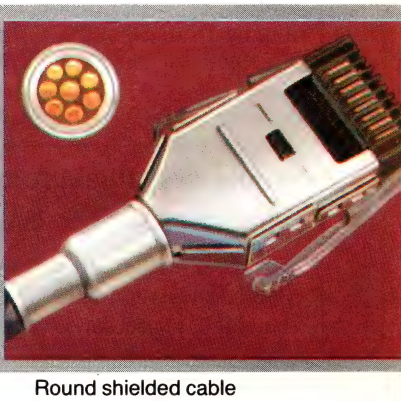

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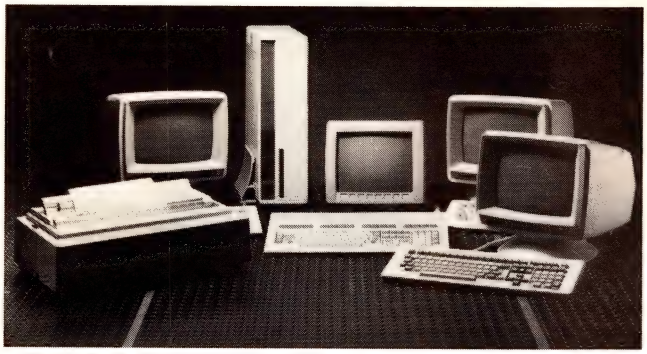


ating system. Targeted at both systems integrators and end users, the computer is available as a processor only for $3,937 each in lots of 100, or for $5,115 as a complete system.

The 7350A features the 68000 processor with the UniPlus port of Unix System III. The system supports up to five users and offers memory sizes from 512-K bytes to 3 megabytes (using 256-K random-access memory chips), a choice of 15- or 28-megabyte hard-disk drives, a floppy-disk drive, optional monochrome or color graphics, and an optional IEEE-488 bus. Thanks to the 256-K RAMs, the system's 8-MHz 68000 operates at full capacity without degradation caused by wait states.

The software complement includes a variety of UniPlus packages tailored to the various needs of system builders, including single-user and multiuser applications, and word-processing and C development packages. Other programming languages available include Fortran, Basic-Plus, RM-Cobol, and Sibol.

In addition to the computer system, Perkin-Elmer has announced extensive additions and enhancements to its data-communications products. These include IEEE-802.3 (Ethernet) support for Xelos, Perkin-Elmer's Unix implementation; an enhancement to PENnet Plus (the firm's standard networking product) that will link the new 7350A on a PENnet; support of the IBM Host Command Facility and Distributed Systems Executive applications; Systems Network Architecture terminal support; and the addition of 3270 terminal support within Perkin-Elmer's bisynchronous gateway product set.

Most of these products are available now at prices ranging from $4,500 for the SNA/HCF support package to $1,400 for the BSC/3270 support package.

Perkin-Elmer, Data Systems Group, 2 Crescent Place, Oceanport, N.J. 07757. Phone (201) 530-5900 [Circle 340]

Single- and dual-processor systems added to line

Four new models are being added to the DPS 88, Honeywell Inc.'s top-of-the-line large-scale computer system. The single-processor DPS-88/41 and dual-processor DPS 88/42 have approximately two thirds the processing power of the full-scale 88/42 mainframes, the company says.

The DPS 88/41 system includes a central processing unit, a 16-megabyte main memory unit, an input/output transfer unit, a channel-adapter unit with 31 channel slots, a system support facility, system maintenance consoles, and a thermal exchange pump. The basic system sells for $1.8 million. The DPS 88/42 includes the same components as the DPS 88/41 plus an additional CPU, system support unit, and thermal exchange pump. It is priced at $2.95 million.

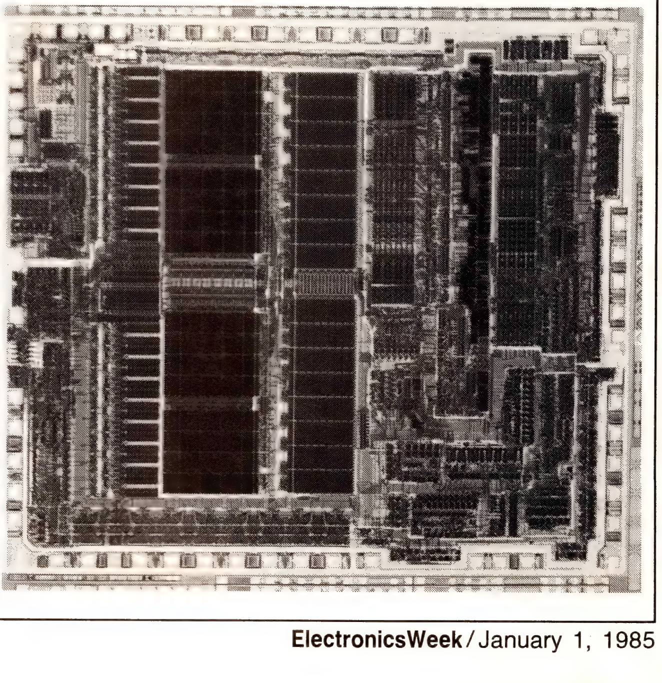
Also being introduced are redundant versions of each system. The DPS 88/42T and DPS 88/82T are configured with two of each central system component. These systems also include 32 megabytes of main memory. The purchase price of the 88/42T is $3.7 million and of the 88/82T, $4.8 million. The company has a four-year leasing plan on all of the systems.

The DPS 88/82T is available now; the other three systems will be available later this quarter.

Honeywell Inc., P.O. Box 8000/A-79, Phoenix, Ariz. 85066. Phone (602) 862-6140 [Circle 341]

Version of 80186 is clocked at 10 MHz

Tossing its hat into the 80186 microprocessor arena, Advanced Micro Devices Inc. is currently shipping a 10-MHz version of Intel Corp.'s popular microprocessor. In addition to the 10-MHz version, AMD is offering 6- and 8-MHz versions. An 8-MHz version is also available for



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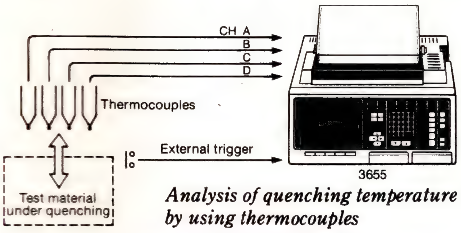
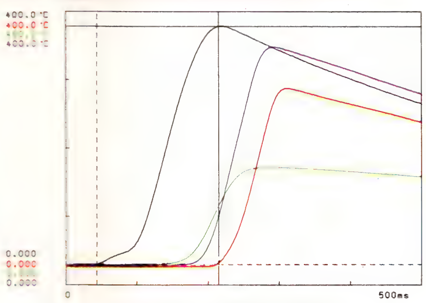


Analysis of quenching temperature by using thermocouples



An example of 3655 plotting

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The buffer memory gives up to 32K words/channel. Available options are a 32K word data memory module, FFT module, and GPIB interface. Your field is well covered with the Model 3655. Real time and memory modes, and simple menu programming round out the promise of performance it makes industry-wide. For more information, contact Yokogawa Corp. of America, (404) 253-7000. In Europe: Yokogawa Electrofact B.V. (The Netherlands), (0) 33-10543. In Japan: Yokogawa Hokushin Electric Corp., (03) 349-0621.

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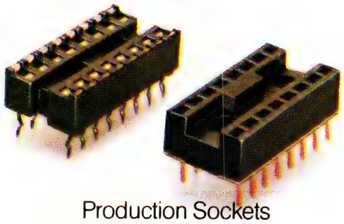

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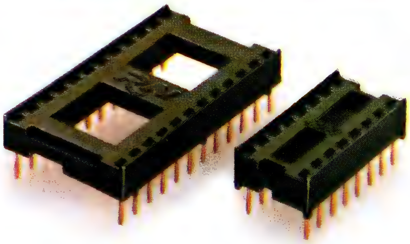

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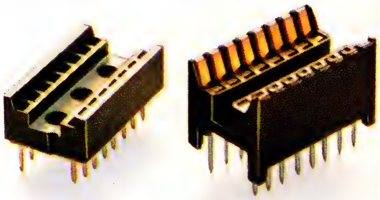

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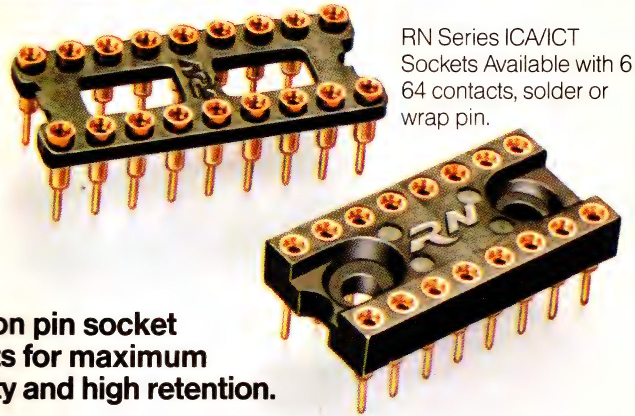

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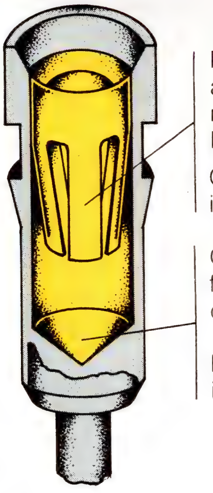
- Lowest insertion force—5 ounces, maximum
- .180" solder tail length available



Four-finger BeCu contact assures solid gastight mating, even with short leads.

Contact available in gold or tinplate.

Closed bottom prevents flux and solder contamination.

Brass shell available in gold or tinplate.

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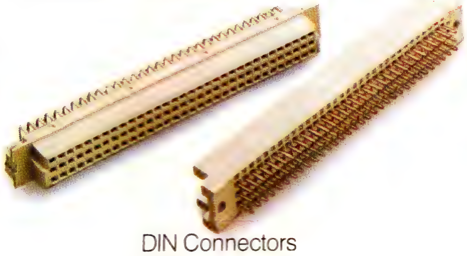
for information on the full line of RN sockets, contact:
Robinson Nugent, Inc., 800 E. Eighth St., Phone: (812) 945-0211.
New Albany, IN 47150. Circle No106

. . . connect with quality

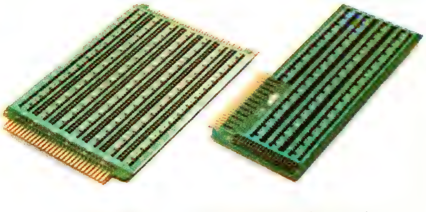
Robinson Nugent

800 East Eighth Street, New Albany, Indiana 47150 ▪ Phone: (812) 945-0211
In Europe: Rue St. Georges 6, CH 2800 Delémont, Switzerland ▪ Phone: (066) 22 98 22

Flat Cable Connectors
Circle No. 103



DIN Connectors
Circle No. 104



Quick/Connect Prototype Boards
Circle No. 105

use over the full military temperature range: –55° to +125°C. The 10-MHz version, packaged in a 68-pin leadless chip carrier, is priced at $98 each in lots of 100 pieces or more.

The processor will be available in a pin-grid-array package sometime in the first half of the year.

Advanced Micro Devices Inc., 901 Thompson Place, Sunnyvale, Calif. 94086. Phone (408) 732-2400 [Circle 342]

Single-chip computer carries 512 bytes of EEPROM

Produced in Hi-CMOS technology, a single-chip microcomputer dubbed the MC68HC11A8FN provides highly sophisticated on-chip peripheral functions, low power consumption, high noise immunity, and high-speed operation. The computer is fully upward object-code-compatible with the M6801 family and provides an improved instruction set that includes two programmable power-saving operating modes—stop and wait—as well as many new 16-bit instructions.

The single-chip computer is designed to run at a 2-MHz bus speed across a –40°-to-+125°C temperature range. On-chip memory includes 8-K bytes of read-only memory, 512 bytes of electrically erasable programmable ROM, an 8-channel, 8-bit analog-to-digital converter, an enhanced set of serial ports, timer functions, and parallel ports with full hardware capacity.

Major functional additions to the central processing unit, which is an extension of the 6801 CPU, include a second 16-bit index register, two types of 16-by-16 divide instructions, a stop instruction, and bit-manipulation instructions. As in the 6801, the CPU of the MC68HC11A8 is implemented independently from the input/output, memory, or on-chip peripheral configurations.

The chip is available in a 52-lead plastic leaded chip carrier and will soon be available in a 48-pin dual in-line package. When in production quantity in the second quarter, the part will sell for $20 each in large volumes. Samples are available now.

Motorola Inc., Microprocessor Products Division, 3501 Ed Bluestein Blvd., Austin, Texas 78721.
Phone (512) 440-2034 [Circle 343]

Surface-mountable coils reach high frequencies

With standard inductance ranges from 0.06 to 10.0 μH with a Q up to 80, a line of surface-mountable microcoils, the MC series, is available with a solderable edge that allows visual inspection of the reflow solder joint.

The microcoils feature a high self-resonant frequency for use at greater frequencies than are currently available in surface-mountable coils, the company claims. The MC series is designed with a flat top for use with vacuum-type pick-and-place equipment, and also makes use of tinned copper pads instead of plated pads; this eliminates the problems usually associated with silver leaching during soldering.

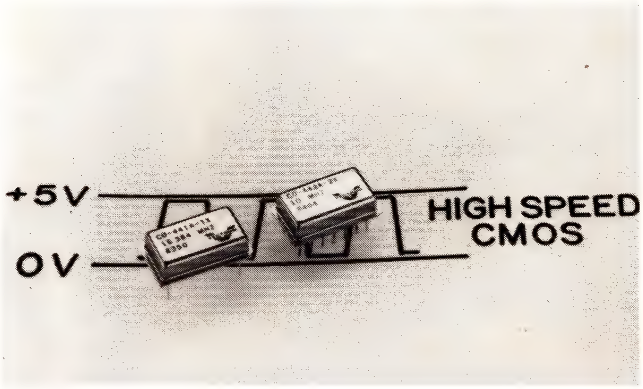
The surface-mountable coils are available approximately seven or eight weeks after ordering.

Standex Electronics, 4538 Camberwell Rd., Cincinnati, Ohio 45209. Phone (513) 871-3777 [Circle 344]

CMOS clock oscillator in a DIP is available at 50 MHz

A high-speed CMOS clock oscillator, housed in a dual in-line package, is available now at any frequency from 1 Hz to 50 MHz. Stability is said to be ±25 parts per million over the temperature range from 0° to +70°C. Optionally available are parts with a MIL rating of ±50 ppm over the range from –55° to +125°C and an improved-stability version with a ±5-ppm rating from 0° to +50°C.

The oscillator can drive Schottky TTL, low-power Schottky, and CMOS devices. It operates from 5 V dc, although operation at 3 V dc is available. Typical rise and fall times of the output are 3 to 6 ns, depending on frequency.

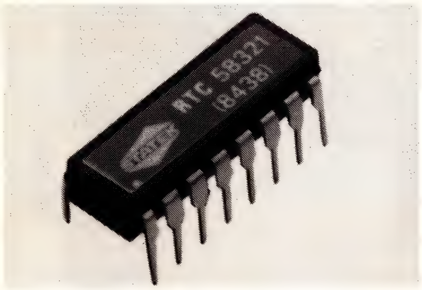


The CO-400 series oscillators are available with either a 4-pin or 14-pin DIP-compatible header, and the oscillators can be screened according to level B of MIL-O-55310/18. A rugged three-point crystal mount lets the oscillator withstand random vibrations of 20 g (when operating at 200 kHz).

Pricing varies with frequency, stability, and screen option, but typical prices in lots of 25 pieces start at $64 each. Delivery takes 10 weeks.

Vectron Laboratories Inc., 166 Glover Ave., Norwalk, Conn. 06850 [Circle 345]

DIP houses real-time clock and crystal oscillator



When substituted for conventional real-time clock devices, the RTC-58321 clock module eliminates the need for external resistors, capacitors, and crystal. The module incorporates a CMOS real-time clock and a complete crystal oscillator in the same 16-pin dual in-line package.

The manufacturer says that by using the part, savings can be achieved in design time, procurement, inventory, assembly, and testing. Because the clock module replaces about five components, board space is also conserved.

The RTC-58321 has a low operating current and a low-voltage battery-backup feature. In lots of 1,000 pieces, the clock sells for $6 each. Delivery is from stock.

Statek Corp., 512 N. Main St., Orange, Calif. 92668.
Phone (714) 639-7810 [Circle 346]

Winchester disk drive stores 51 megabytes

A 5¼-in. half-height Winchester disk drive, the model TM755, provides an unformatted storage capacity of 51 megabytes on plated rigid disks. The disks are manufactured by a sputtered hard-overcoat process for higher bit density and, according to the manufacturer, for increased ruggedness compared to conventional processes.

The TM755 uses only 23 W of power and features an average access time of 35 ms. ST506 and 412 interfaces are standard for multiuser microcomputer and minicomputer busi-

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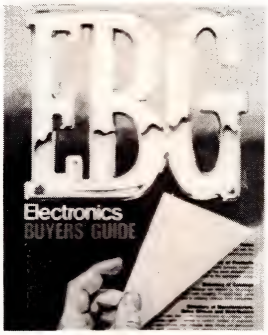
Circle 107 on reader service card



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ness systems and other applications where large library space is required. In large quantities, the TM755 is priced below $900. Samples are available now.

Tandon Corp., 20320 Prairie St., Chatsworth, Calif. 91311.
Phone (818) 701-4602 [Circle 347]

Streaming tape drive also does transactional work

A fully automatic tape-loading and -threading unit, the model DMT2000, gives the user the installation choice of two tape speeds, 100 in./s or 25 in./s, to match the desired application—disk backup, file organization, or transactional data processing. The tape format is fully compatible with American National Standards Institute and IBM Corp. standards, easing conventional data exchange with other systems.

The DMT2000 allows four settings for reinstruct time, which provides flexibility in adjusting to the system's throughput without tying up software needed for other tasks. An auxiliary interface allows transmission of formatter status to the host computer, which the manufacturer says eases error logging on the host side, a necessary point for preventive maintenance.

Mean time between failures for the DMT2000 is said to be 7,400 h. Self-diagnostics, controlled from the front panel, are capable of testing (among other functions) the tape drive's read/write and positioning, and if internal inspection of the mechanism is necessary, the circuit board can be rotated through 180° for examination.

Prices for the DMT2000 start at $3,985 each, and delivery will be made in two to four weeks.

Anritsu America Inc., 128 Bauer Dr., Oakland, N.J. 07436.
Phone (201) 337-1111 [Circle 348]

Custom mouse runs through AT&T's 6300 computer family

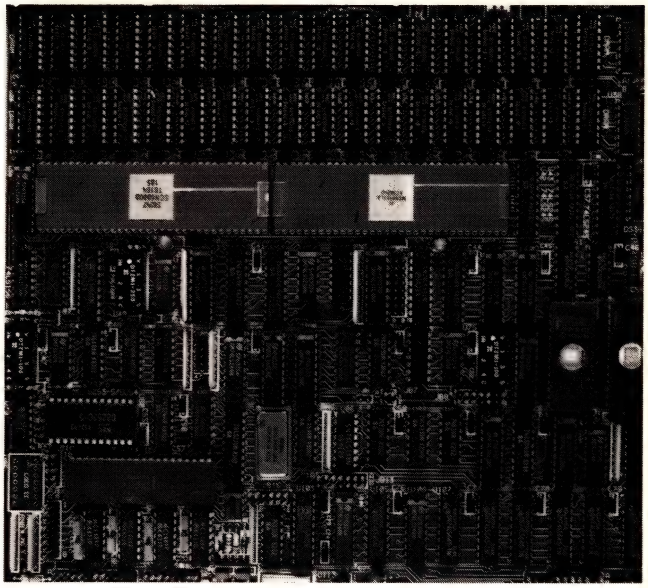
A special port at the back of the AT&T Co. 6300's keyboard accepts the Mouse 6300, which is compatible with any application package that runs on this personal computer. If the program is "mouseless," custom driver and configurator software allows users to program the mouse's buttons, movement, and resolution.

Draw/Writer software is part of the Mouse 6300 package—an interactive program that combines text and graphics and is also a file editor. It is designed to increase the user's proficiency with the mouse. Available now, the Mouse 6300 is priced at $150. The mouse is also available from AT&T through its direct sales force.

Logitech Inc., 805 Veterans Blvd., Redwood City, Calif. 94603.
Phone (415) 365-9852 [Circle 349]

VME processor board also has 1 megabyte of RAM

The DVME-102, a single-card 68000/68010-based central processing unit, offers 1 megabyte of dynamic random-access memory running without wait states. Input/output and memory are dual-ported; two serial RS-232-C channels support either synchronous or asynchronous modes, and two independently controlled baud-rate generators are provided. On-board systems controller functions include system clock, bus time out, single-level arbiter, power-on, and push-button reset.



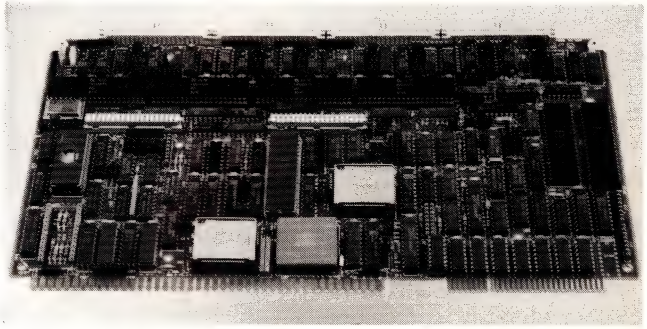
Two 28-pin sockets are provided for byte-wide programmable read-only memory as well as one software-controlled light-emitting diode for status indications. Byte-parity generation and checking is present for on-board DRAM, and a 68451 memory management unit is optional. The DVME-102 is available now for $5,063.

DY-4 Systems Inc., 1475 S. Bascom Ave., Suite 202, Campbell, Calif. 95008. Phone (408) 377-9822 [Circle 353]

80188-based communications computer runs 12 terminals

Functioning as a cluster controller, a front-end processor, or working alone, the iSBC 188/48 single-board communications computer can control various input/output devices with eight interfaces. On-board firmware supports up to 12 asynchronous terminals for management of multiuser or multiprotocol communications tasks.

The 188/48 contains an 80188 microprocessor, four 82530 serial communications controllers, 64-K bytes of dual-ported random-access memory, and two universal memory sites accommodating up to 64-K bytes of pro-



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GRAPHIC LCD UNIT **LM64004G**

Graphic display type

Model No.	Display Format (dot × dot)	External Dimensions W × H × D (mm)	Controller LSI Part Number
LM24002G	240 × 64	260 × 80 × 14	LR3691
LM24003G	240 × 128	241 × 125.3 × 14	LR3691
LM48003G	480 × 64	290 × 70 × 12	LR3691
LM48004G	480 × 32	290 × 52 × 12	LR3691
LM48008G	480 × 128	261 × 96 × 12	LR3691
LM48010G	480 × 200	261 × 130 × 12	LR3691
LM64004G	640 × 200	272 × 109 × 12	LR3692*

*Available Soon

SHARP

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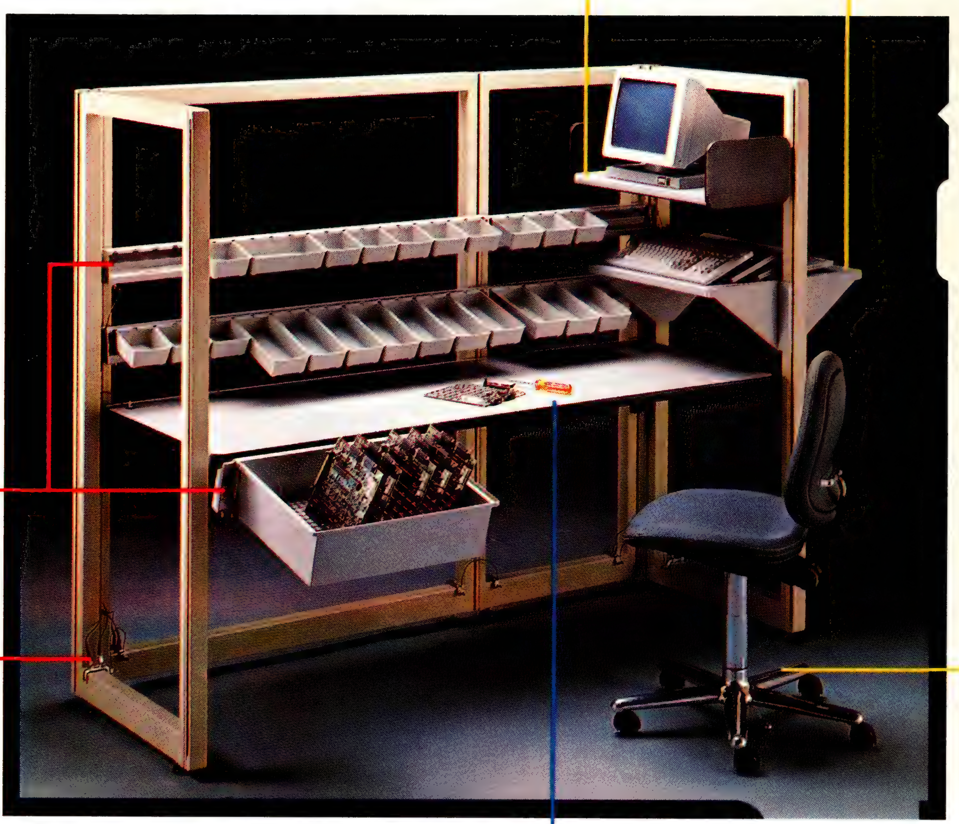
Electronic Components Dept.

Static Protective Work Station

Conductive dispensing rails and hanger rails provide a location to interface with material handling components. These rails are vertically adjustable in one-inch increments and each includes a one mega Ω resistor in its grounding wire.



Grounding clamp kits provide a complete static protective work station by delivering a continuous ground path from components and frames to earth ground.

Static protective work surfaces are constructed of static dissipative, heat and chemical resistant laminate. Top surface resistance in 10^9 ohms per square (per ASTM D257). A one mega Ω resistor is located in the grounding wire to insure safe current flow.

For more information on static protective work stations and other Herman Miller products for the Electronics industry call 800 851-1196 (In Michigan 616 772-3442).

Systems for office, health care, laboratory and industrial environments.

Electronics Industry
Technical Report 5

Static protective center shelves and storage/display shelves are adjustable in one-inch increments to provide effective use of vertical space. Electrical performance is $8x10^7$ ohms per square (per ASTM D257). A one mega Ω resistor is located in the grounding wire to ensure safe current flow.

The Ergon static protective chair provides extraordinary comfort, freedom of movement and easy adjustment in addition to providing a direct conductive path to ground. Typical resistance of the chair is $10^6 – 10^9$ ohms.

herman miller

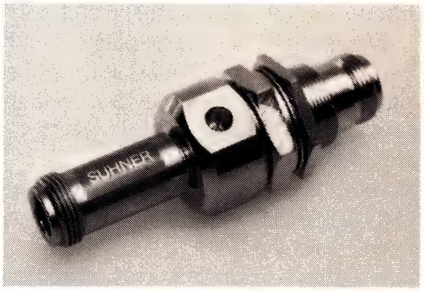
Circle 111 on reader service card

grammable read-only memory or erasable PROM. The 188/48 supports the iRMX and Xenix operating systems. Two Multimodule expansion boards are available: The iSBC 307 board will increase on-board RAM to 192-K bytes with parity, while each iSBX 354 board adds two serial I/O channels.

The iSBC 188/48 is priced at $2,995, and the iSBX 354 and iSBC 307 expansion boards are $450 and $800. All are available now.

Intel Corp., 5200 N.E. Elam Young Pkwy., Hillsboro, Ore. 97123. Phone (503) 640-7147 [Circle 354]

EMP protectors guard against surges above 2.5 GHz



Custom-built protectors for communications equipment operating at microwave frequencies are said by the manufacturer to be effective against both lightning and nuclear electromagnetic pulses. The quarter-wave shorting-stub technique provides a nearly resistance-free current path for the surge while still allowing radio-frequency operation to continue. In the operating band, the voltage standing-wave ratio and insertion loss are said to be negligible. Custom-built, the protectors are priced according to configuration.

Huber & Suhner AG, RF and Microwave Division, CH-9100 Herisau, Switzerland. Phone (071) 53-15-15 ext. 388 [Circle 355]
Uniform Tubes Inc., MicroDelay Division, 200 W. 7th Ave., Collegeville, Pa. 19426. Phone (215) 539-0700 [Circle 355]

Circuits link digital phones with voice/data PBX

Targeting the growing demand for both voice and data capabilities in private branch exchanges, two digital-loop-transceiver integrated circuits, the MC145418 and the MC145419, give digital telephone sets high-speed data access to the PBX switching facility. Digital signals are transmitted bidirectionally over normal telephone-wire pairs at a rate of 64 kb/s for voice data and 16 kb/s for signaling data.

Each digital-loop-transceiver IC is a complete transmitter/receiver that provides 80-kb/s half-duplexed data communications over twisted-wire, coaxial-cable, or fiber-optic connections. Operating with a single 5-to-8-V power supply, the transceivers can be driven by either TTL or CMOS signals.

The MC145418 master digital loop transceiver replaces the codec-filter and subscriber-line interface circuit on the PBX line card and transmits data bidirectionally over the wire pair to the telephone set. The MC145419 slave transceiver is located in the telephone set and interfaces the monocircuit to the wire pair.

By hooking two transceivers back to back, a repeater can also be formed. The digital loop transceivers are protocol-independent and compatible with existing telephone switch architectures and call-signaling schemes.

Mounted in a 22-pin plastic dual in-line package, the MC145418 and MC145419 are priced at $7.91 in 10,000-piece quantities. Samples are available now, and production quantities will be shipped during the first quarter of this year.

Motorola Inc., Logic and Special Functions Products Division,
3501 Ed Bluestein Blvd., Austin, Texas 78721.
Phone (512) 928-6892 [Circle 356]

Satellite TV transmitter tests DBS-TV receivers

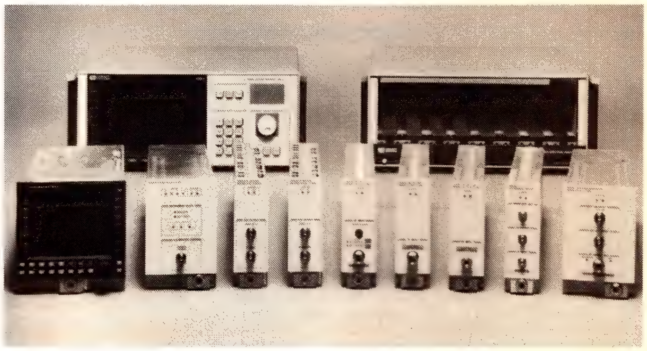
A three-channel satellite TV signal transmitter, the MG717A, is designed to test direct-broadcast satellite TV receivers operating in the 12-GHz band. It can also test 2.5-, 4-, and 11-GHz receivers in conjunction with a converter. Features include an IEEE-488 interface for remote operation, ability to perform a frequency sweep of a single channel range, and a memory that stores up to nine front-panel settings.

The output level is –30 dBm/channel; differential gain is no more than 2%/±13.5 MHz, and differential phase is no more than 2°/±13.5 MHz. Waveform distortion is less than 2% and video signal-to-noise ratio is at least 60 dB. Available options are an output attenuator to change the output-level range from 0 to 70 dB in 1-dB steps and a subcarrier for FM voice modulation.

The price of the three-channel MG717A is $29,900, and units are available now.

Anritsu America Inc., 128 Bauer Dr., Oakland, N.J. 07436.
Phone (201) 337-1111 [Circle 357]

Modular spectrum analyzer covers 100 Hz to 325 GHz



The HP 7000 family of modular measurement-system components—including a mainframe enclosure, two display units, and a number of modules—can be assembled to build a spectrum analyzer. A system with more than one independent instrument (such as a programmable signal generator) can also be configured, with the advantage of central operator control and the ability to monitor all instruments from one display unit. The first modules offered allow manual and automatic spectrum analysis from 100 Hz to 325 GHz.

The purchaser needs to buy only those system components required for present measurement tasks. The initial offering includes the HP 71001A radio-frequency module (100 Hz to 2.9 GHz), the HP 71002A microwave module (50 kHz to 22 GHz), and the HP 71003A millimeter-wave module (whose coverage depends on the external mixers used). Each system is contained in one mainframe and has an HP 70205A graphics-display module.

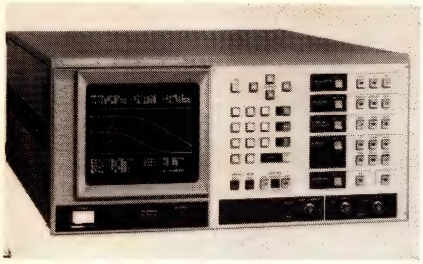
Individual modules, mainframes, and displays may be ordered, or a custom system will be assembled by the factory. Prices are as follows: HP 71001A, $31,500; HP 71002A, $34,000 (22 GHz) and $35,500 (26.5 GHz); HP 71003A, $32,000 (mixers not included); HP 70205A, $1,800. Other modules are priced between $1,800 and $13,900. Any of these units will be shipped in eight weeks.

Hewlett-Packard Co., Inquiries Manager, 1820 Embarcadero Rd.,
Palo Alto, Calif. 94303 [Circle 358]

Response analyzers measure frequencies from 0.0001 Hz

Using fast analog-to-digital processing, two frequency-response analyzers—the 5050, with an integral cathode-ray terminal, and the S-5720B—are general-purpose microprocessor-based instruments that measure frequencies from 0.0001 Hz up to 100 kHz.

The 5050 performs measurements at 18,000 maximum



sampling points with an amplitude accuracy of 0.05 dB and a phase accuracy of 0.2°. It features more than 140 dB of dynamic range and a high common-mode-rejection ratio. A menu-driven setup of measurement parameters on the 5050 displays the instrument's measurement status. Memory with battery backup can store and recall 10 types of setups. To make measurements more accurate and convenient, the integration function can be optimized on internal calculations based on the signal-to-noise ratio. Output devices include an integral cathode-ray tube and an optional X-Y recorder and video printer for hard copy.

The S-5720B, an enhanced version of the firm's S-5720, is a two-channel, fast Fourier integration analyzer that can measure amplitude and phase in one signal cycle. With a new 15-V generator instead of a 10-V generator, its amplitude accuracy is ±0.1 dB, its phase accuracy is ±0.2°, and its resolution is to within 0.01°. The 5050 sells for $19,900, the S-5720B for $17,500. Delivery of each takes 60 days.

Moxon Electronics, 1970 S. Santa Cruz St.,
Anaheim, Calif. 92805.
Phone (714) 635-7600 [Circle 359]

Dc-to-dc converters weigh in at 3.5 oz

Two miniaturized power supplies, the PKA 4232 and the PKA 2232, are lightweight and occupy a space of 3 by 3 by 0.68 in., making them suitable for printed-circuit-board mounting, the manufacturer says. Both are 25-W models, providing outputs of 5 V at 3.2 A and ±15 V at 0.32 A. The inputs are –48 V for the PKA 4232 and +24 V for the PKA 2232.

The converters operate from –45° to +85°C without any derating of the output power, and the efficiency

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Circle 113 on reader service card

is typically 81%. Switching frequency is 300 kHz, with a recovery time of 50 μs.

Other features include soft start, remote control, input sense with shutdown at undervoltage, and an output adjust with a range of ±10%.

In original-equipment-manufacturer quantities, both items are priced at $50; delivery is from stock.

Rifa Inc., Greenwich Office Park 3, Greenwich, Conn. 06830.
Phone (203) 625-7300 [Circle 360]

Inverter operates in parallel for outputs to 1.5 kVA

Providing 117 V ac, 60-Hz sine-wave power at 250 VA maximum continuous duty from a 48-V battery plant, the I-250R is designed for parallel operation in power plants that consist of up to six inverters for outputs up to 1.5 kVA. Small inverter plants may therefore be expanded at minimal cost when demand increases. Thus for a 500-VA plant, only one additional I-250R is required to provide redundancy.

The I-250R is intended as a primary source of "no-break" ac power for applications where continuity of power is critical, the manufacturer says. It features automatic short-circuit frequency, line synchronization and transfer, thermal overload protection, and extended alarm contacts. Its dimensions are 8.5 in. high by 17.0 in. wide by 12.75 in. deep. The price of the I-250R (48 V) is $10,250, and delivery is from stock.

Pylon Electronic Development Co. Ltd., 2300 Victoria St., Lachine, Quebec H8S 1Z3, Canada.
Phone (514) 637-1186 [Circle 361]

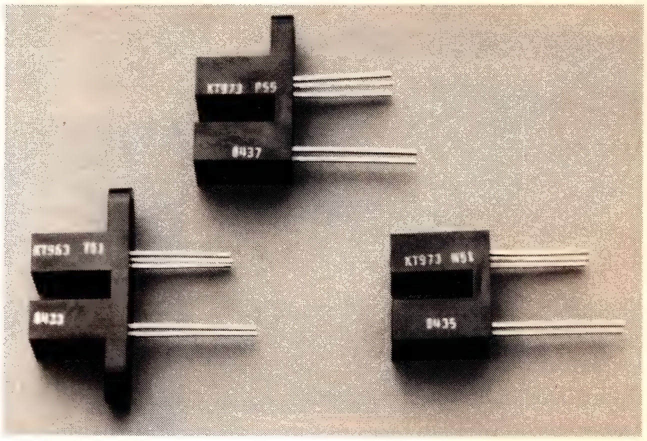
1,200-W switcher fits industry-standard case

Available in output voltages from 2 to 28 V dc, the PM 3026 will fit the 5-by-8-by-11-in. industry-standard case. The PM 3026 is a 1,200-W, single-output, 48-V dc input switching supply that accepts input power over the entire battery-voltage range of 42 to 56 V dc (discharge to full charge). The manufacturer points out that because the switcher is physically interchangeable with an ac input supply, a systems manufacturer can meet both input power requirements with a single system.

Pioneer Magnetics, 1745 Berkeley St., Santa Monica, Calif. 90404.
Phone (800) 848-1745; in California, (800) 233-1745 [Circle 362]

Line of GaAs photo ICs offers 74 configurations

Engineers can specify some custom design features at no additional development cost with the help of a line of photo integrated circuits, the KT960/KT970 series, offered in up to 74 different electrical and mechanical configurations. Each assembly consists of a gallium arsenide infrared-emitting diode that is mounted across a 0.125-in. gap from a photo integrated circuit. Four output options are available: buffer-totem pole, buffer-open collector, inverted-totem pole, and inverted open connector.



Mechanical options include four configurations of the two mounting tabs. Sensor aperture widths are 1.27 mm and 0.25 mm; the aperture on the IR emitter side is fixed at 0.050 mm, but is variable outside the series.

All housings are made of injection-molded polysulfone. The KT960 series features an IR-transparent grade for protection against aperture contamination. The price of the ICs is $2.25 each in lots of 1,000.

Optek Technology Inc., Marketing Department, 345 Industrial Blvd., McKinney, Texas 75069. Phone (214) 542-9461 [Circle 363]

Trio of DMA controllers serves 68000 family

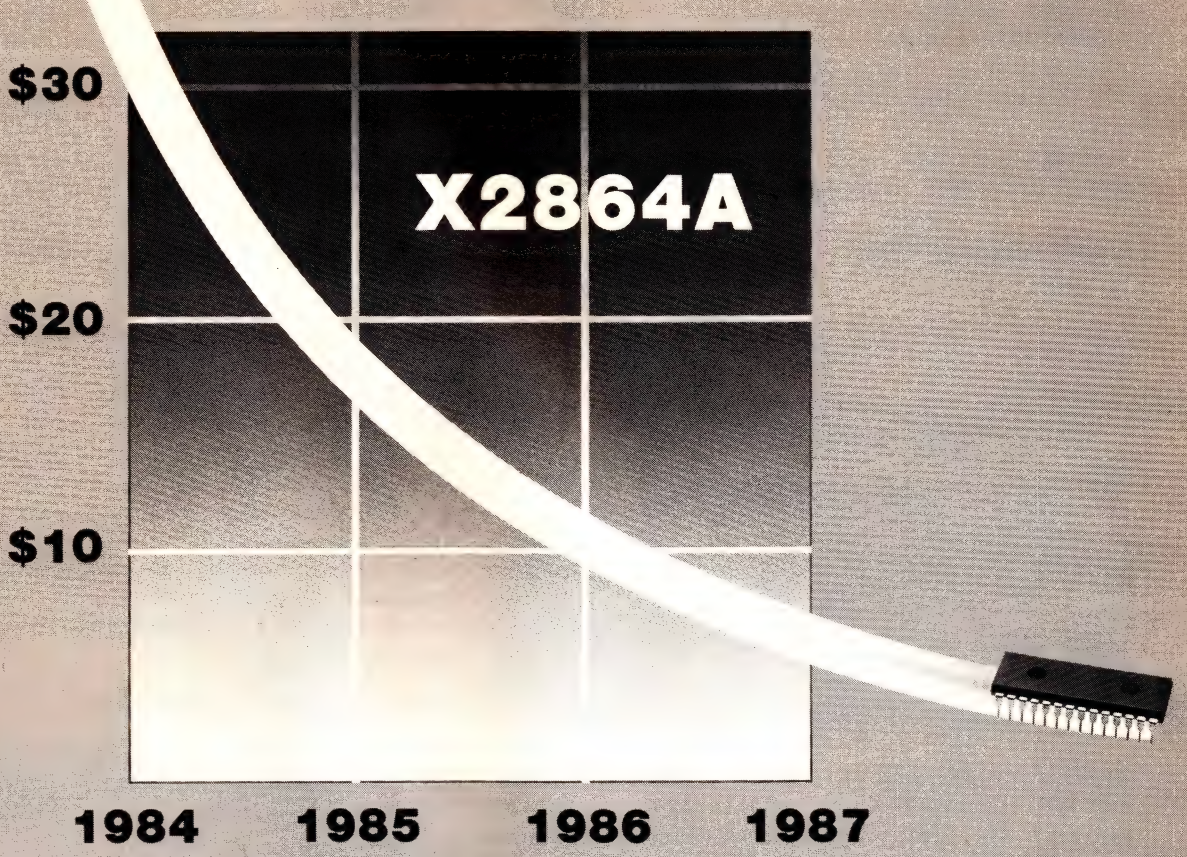
A line of direct-memory-access controllers, the 68440, 68442, and 68450, are directly compatible with the 68000 microprocessor bus architecture and provide full support for all bus exception conditions defined for the 68000 family. Additionally, the controllers are compatible with the VMEbus and Versabus aysnchronous bus standards.

The first chip, the 68440 is a two-channel high-performance device that supports a 24-bit linear address. The 68442 is an extended version of the 68440, providing a full 32 bits of linear addressing and an additional function-code output. The third chip is a four-channel controller that is upward pin- and register-compatible with the 68440.

The programmable function-code outputs of these devices can be used to specify 68000-compatible bus-cycle-type information on each DMA bus cycle. The devices can thereby directly interface with memory-management devices such as the 68451. The additional function code output of the 68442 can be used to distinguish between DMA and central-processing-unit bus cycles.

Each of the three controllers permits four different modes of DMA request generation: externally generated cycle steal, burst mode, internally generated maximum rate, and limited-rate automatic request. The 68440 and and 68442 will be available in 8-, 10-, and 12.5-MHz versions; the 68450 will be offered in 8- and 10-MHz models.

Samples of all parts are available now, with production



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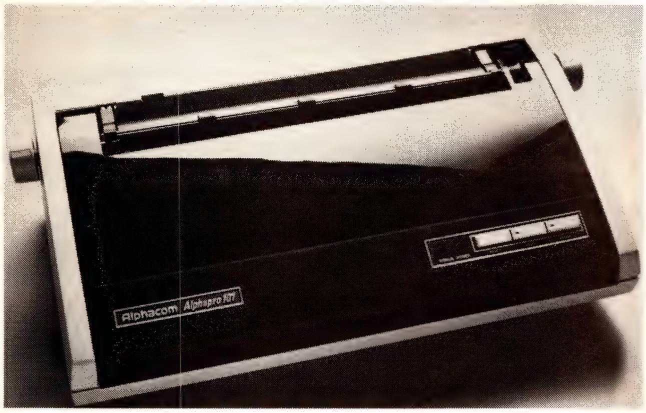
Circle 115 on reader service card

quantities scheduled for availability later in the first quarter. Pricing ranges from $39.69 for the 68440 in 100-piece lots in a 64-pin plastic dual in-line package to $78.43 for the 68450 in like quantities in a 64-pin ceramic DIP.

Motorola Inc., Microprocessor Products Group, 3501 Ed Bluestein Blvd., P.O. Box 6000, Austin, Texas 78762 [Circle 370]

Daisy-wheel printer is priced at $399



Designed for use with all popular microcomputers, the Alphapro 101 a daisy-wheel printer called the is priced at just $399. The printer uses standard Diablo- and Qume-compatible print wheels and ribbon cartridges.

The 20-c/s printer employs an intelligent printer cartridge to adapt it to all personal computers, including those with Centronics ports, such as the IBM Corp. Personal Computer, PCjr, and compatibles, and those with RS-232-C ports, such as the Apple IIe, IIc, and Macintosh.

It also includes path-seeking logic to maximize printing speed and a 93-byte memory buffer (4-K bytes optional). Proportional spacing, boldface, double-strike, strike-out, phantom space, superscripts and subscripts, and reverse line feeds are also supported.

Operator controls include line feed, self-test, paper feed, hammer intensity, reset, and pause. Light-emitting-diode indicators show power-on and out-of-ribbon. Paper sizes up to 13 in. may be used.

The Alphapro 101 is available now.

Alphacom Inc., 2323 S. Bascom Ave., Campbell, Calif. 95008. Phone (408) 559-8000 [Circle 366]

Automated system cleans circuit boards quickly

Engineered for computerized water-and-detergent cleaning and drying of printed-circuit boards, the Century 2000 is a completely automated cleaning system. By using a custom-designed microprocessor with the RS-232-C and RS-422 outputs, it continuously monitors all operating parameters, adjusting them as the product load dictates.

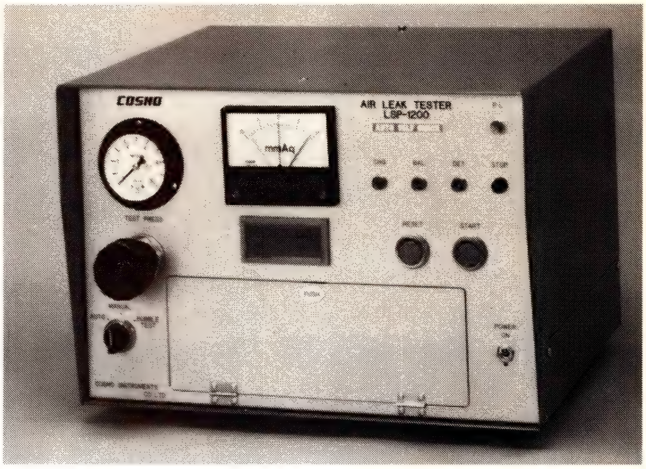
The system is designed to minimize operator intervention and setup. All data for processing is held in memory. Once the parameters for a particular board type are entered in memory, the system sets up automatically. Parameters are set by entering the product code number.

The system also has a built-in interface to allow direct interconnection with other computers. It may be operated from a remote location or monitored from any terminal, and it has print-out capability. It will accept boards or pallets up to 20 in. wide and is capable of speeds up to 20 ft/min.

Completely modular and field-upgradable, the production system is designed for use with biodegradable detergents formulated to remove rosin fluxes and water-soluble organic fluxes. The Century 2000 comes standard with a loading module that will accept either fixed horizontal or inclined entry, and modules for rinse, recirculating-rinse, air-knife, air-knife infrared-dryer, and drive-unload functions. Delivery takes approximately 24 weeks after receipt of order.

Electrovert USA Corp., P.O. Box 458, Camdenton, Mo. 65020. Phone (314) 346-3341 [Circle 367]

Air-leak tester is sensitive to 0.1 mm Aq



The LSP-1200 air-leak tester is an analog instrument that displays the amount of leakage, providing visual indication on go/no-go lamps. The unit also gives an audible alarm and signals external devices.

The tester uses a master/workpiece comparison system, employing differential-pressure detection circuitry to measure the difference between the part under test and an identical, but leak-free, master part. The differential-pressure sensor is sensitive to 0.1 mm Aqua, an internal volume measuring 0.03 in.^{3}, and a maximum pressure rating of 500 lb/in.^{2}.

The LSP-1200 also includes automatic self-diagnostics and automatic zero compensation. Its three-step test cycle includes pressurization of the workpiece and master, an equilibrium period, and the detection process. When detection is initiated, the unit automatically resets to zero.

The tester is available now in two models. The low-

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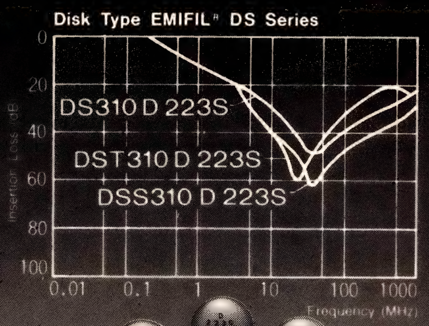

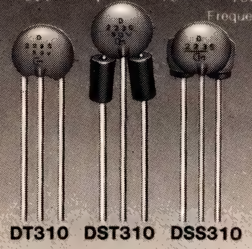

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■RATINGS

Part Number	Capacitor			Ferrite Core
	Capacitance	Rated Volt.	Temp. Char.	
DSS310-55Y5S220M DSS310-55Y5S470M DSS310-55Y5S101M	22pF±20% 47pF±20% 100pF±20%	100V	±10%	inside
DS 310-55Y5S271M DST310-55Y5S271M DSS310-55Y5S271M	270pF±20%	100V	±10%	none outside inside
DS 310-55Y5S222M DST310-55Y5S222M DSS310-55Y5S222M	2200pF±20%	100V	$^{+20}_{-30}$%	none outside inside
DS 310-55Y5S223S DST310-55Y5S223S DSS310-55Y5S223S	22000pF$^{+50}_{-20}$%	50V	$^{+20}_{-30}$%	none outside inside

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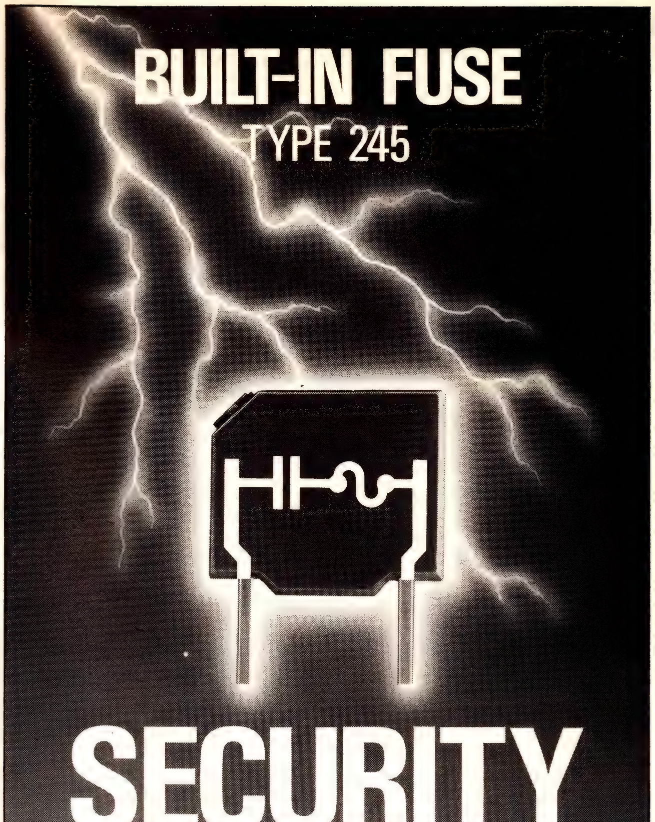

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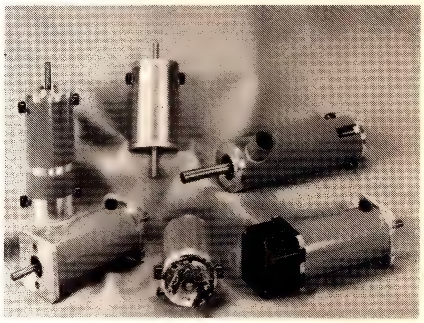
pressure unit applies up to 15 lb/in.^{2} of testing pressure, the medium-pressure model up to 100 lb/in.^{2} The testers are priced in the $6,000 range, with delivery taking two months after receipt of order.

Cosmo Instrument Co., 21415 Civic Center Dr., #11, Southfield, Mich. 48076. Phone (313) 352-6570 [Circle 368]

2¼-in. dc motors boast peak torque of 360 oz-in.



A line of 2¼-in. permanent-magnet dc motors is designed for commercial applications including instrumentation, computer equipment, office equipment, medical and surgical devices, and robotic systems. The motors have high-permeability armature laminations for maximum energy transfer, high-strength steel housings, replaceable brushes, and a diamond-turned copper commutator for a smooth finish.

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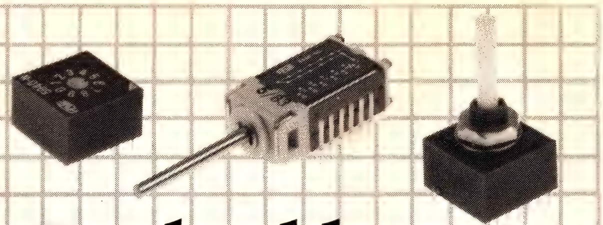
Litton Systems Inc., Clifton Precision Divi-



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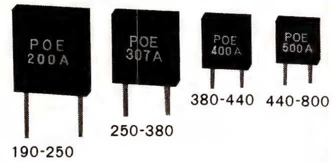

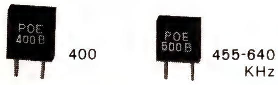

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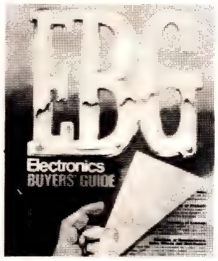

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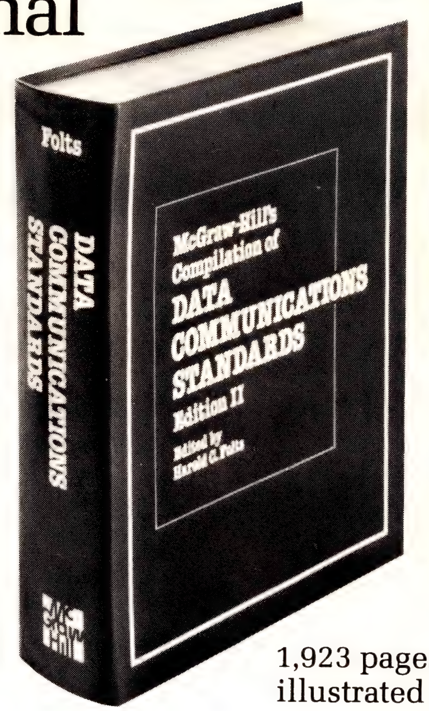
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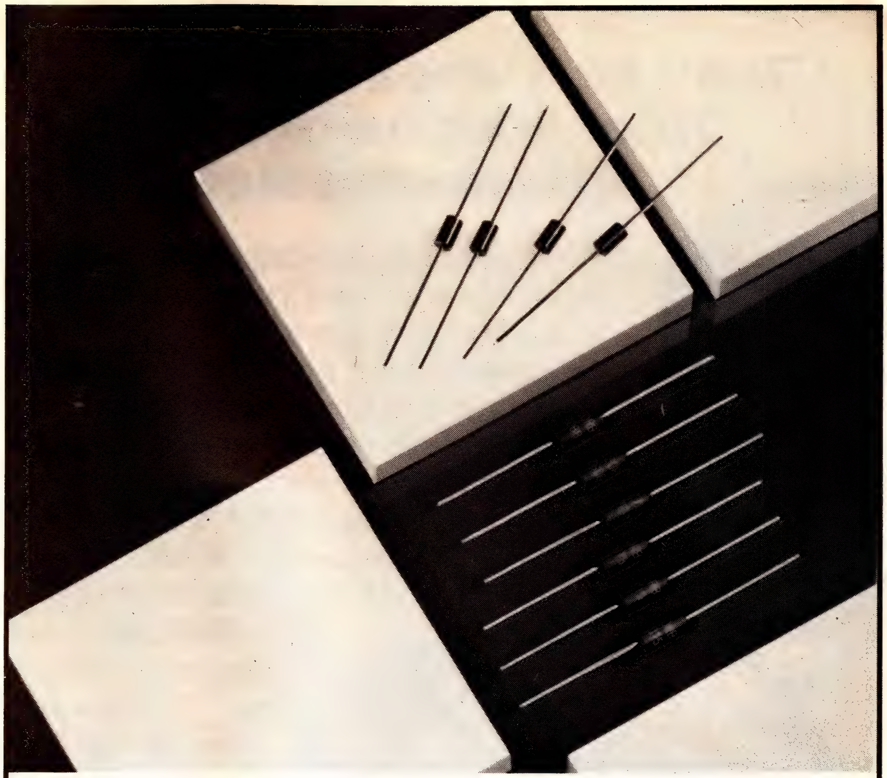
The VSAS package runs on the IBM Corp. Personal Computer AT and all Prime computers. Later offerings are planned for Digital Equipment Corp. VAX 11/780 and other



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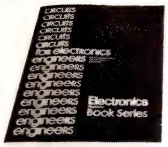

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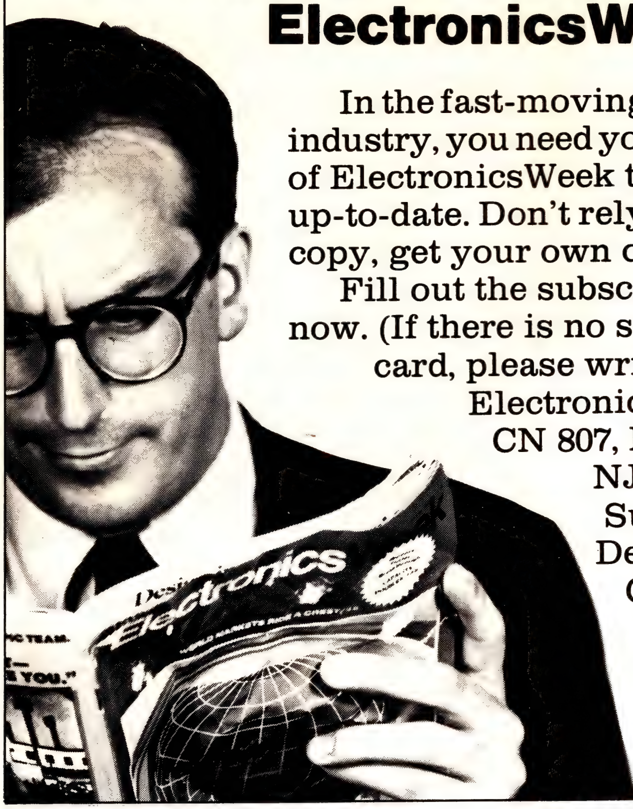

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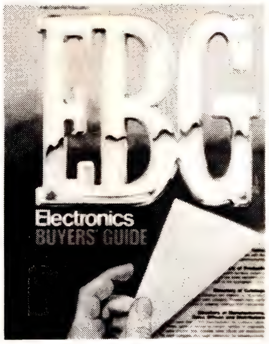

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Wiremaster version 5.15, a software tool for design, layout, and construction of wrapped-wire, multiwire, and printed-circuit boards, runs on many popular computers, including the IBM Corp. Personal Computer, machines that use CP/M and MS-DOS operating systems, and Digital Equipment Corp.'s VAX. Wiremaster 5.15 generates net lists, wire lists, parts lists, cross references, and checklists. A companion program, Changemaster, keeps track of modifications and updates, while Plotboard, a graphics software package, produces pictures of the board using most dot-matrix printers.

Location accuracy with the Wiremaster 5.15 is to within 0.001 in., the manufacturer says, with provision for twisted-pair and coaxial wiring. Input language expansions handle special components such as connectors, and post-processors are available for driving numerically controlled wiring machines.

The basic Wiremaster 5.15 package, which includes Changemaster, is available now for $195. Updates are priced at $25 to owners of earlier versions. Plotboard, available separately, costs $75.

Afterthought Engineering, 7266 Courtney Dr., San Diego, Calif. 92111.
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VMEbus

PRODUCT ANNOUNCEMENT

SAIC is introducing a complete product line based on the VMEbus. The product line includes digital I/O, analog I/O, AC I/O, pulse rate I/O, synchro/resolver and host computer interfaces. SAIC's product line offers a complete I/O solution for the VMEbus. The digital I/O modules feature 64-bit TTL I/O, 128-bit TTL I/O, 32-bit change-of-state digital inputs, and a wide range of other I/O solutions for the VMEbus including optically coupled I/O modules and telecommunication I/O modules. SAIC's VME megamodule product line features a subset of I/O modules that support built-in-test logic, 8-,16-, and 32-bit transfers.

The SAIC analog I/O product line features an analog private bus on the P2 backplane that supports SAIC's analog-to-digital converter and low-cost multiplexer expansion modules. A subset of the analog product lines features built-in-test logic for isolating failures to the card level. The analog product line includes a 32-channel multiplexer, 64-channel multiplexer, a high-speed 40KHz ADC with on board multiplexers, a low cost ADC module with programmable gain and end of conversion interrupts. The analog product line also includes a 16-channel analog output module that features external update strobes and double buffered D/A converter.

The SAIC synchro/resolver product line supports a wide range of references and is designed with built-in-test logic to support fault isolation to the card level. The digital to synchro/resolver module is a dual-channel converter and is available with both 1.5VA and 4.5VA options.

The host computer interface product line includes a DR11W for communicating with Perkin-Elmer, Data General, DEC, Harris and Prime computers, a Gould/SEL HSD interface that supports 32-bit transfers and a VME-to-VME DMA link, that supports 8-, 16-, and 32-bit transfers.

Other SAIC VMEbus products include a VMEbus repeater for configuring large I/O subsystems without intelligence on the repeated bus. Delivery is 90 to 120 days, ARO.

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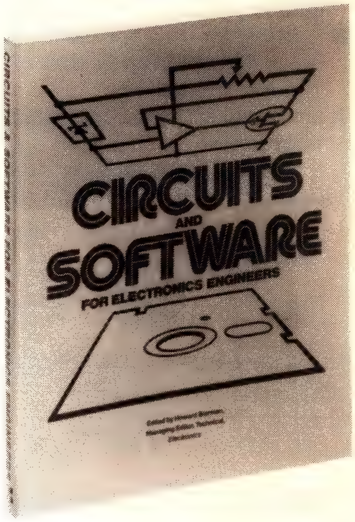

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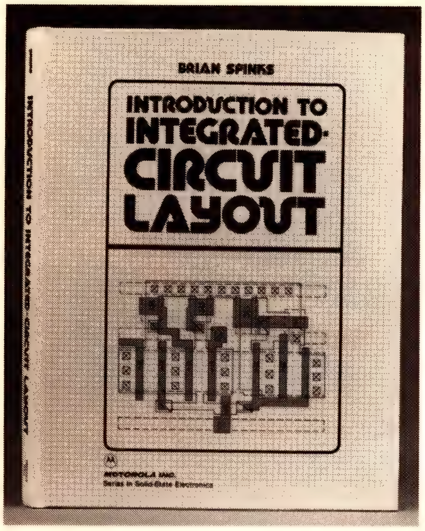
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School's in session. A prolific publisher and distributor of design and data manuals, application notes, and other assists, Motorola Inc. has recently added the free *Memory Data Book*; *CMOS/n-MOS Special Functions Data Manual* (single copies $1.60); a textbook, *Introduction to Integrated Circuit Layout*, by Brian Spinks (hardcover $24.95, softcover $19.95); and *Macrocell Array Design Manual* (single copies $3.50) to its list. For ordering information, speak with the company's Literature Distribution Center, (602) 994-6561, and also ask for their Catalog of Technical Literature in Inventory. The mailing address is P.O. Box 20924, Phoenix, Ariz. 85036.
[Circle reader service number 421]

Preceding proceedings. IEEE Press, the book-publishing arm of the Institute of Electrical and Electronics Engineers, has just announced the publication of *VLSI: Technology and Design*, material combined and re-edited from two special issues of the *Proceedings.* The volume editors are Otto C. Folberth, director of science and technology for IBM Germany, and Warren D. Grobman, manager of advanced packaging development at IBM's General Technology Division. Priced at $25.20 for members and $41.95 for nonmembers, this 320-page book should be ordered from the IEEE Service Center, 445 Hoes Lane, Piscataway, N.J. 08854. A $2 billing charge is added to orders not prepaid. [Circle 422]

High I.Q. Robotics and artificial intelligence are the subject of an ongoing applications series whose initial volumes are edited by William D. Gevarter, formerly manager of Automation Research and Technology for the National Aeronautics and Space Administration. *Artificial Intelligence and Robotics: Five Overviews* is described in a leaflet from the publisher, Business/Technology Books, P.O. Box 574, Orinda, Calif. 94563; phone (415) 839-3370. [Circle 423]

Hello, Central. The latest modem standards are among the topics covered in the revised edition of *The V-Series Report,* a paperback about data communications that explains what the CCITT recommendations mean in practical terms. Published by Bootstrap Ltd., it's available for $30 from the U.S. distributor, Glasgal Communications Inc., 207 Washington St., Northvale, N.J. 07647; phone (201) 768-8082. [Circle 424]

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sion has published a report entitled "Diode Laser Arrays With High Power in the 4- to 5-Micron Infrared Region," covering lead-salt arrays emitting 100 mW of continuous-wave power. It's available free from Customer Service at (617) 275-2650; the company is located at 25 Wiggins Ave., Bedford, Mass. 01730. [Circle 426]

Now hear this. A revised chapter of the "International Electrotechnical Vocabulary," covering acoustics and electroacoustics and describing levels, transmission and propagation, microphones and other apparatus, and more has just been published by the International Electrotechnical Commission. For order information, write to the Information Officer, IEC, at 1 Rue de Varembé, 1211 Geneva 20, Switzerland, concerning publication 50 (801). [Circle 427]

Versatile organic compound. Phenol, an organic compound widely used inside and outside the electronics industry as a resin, is presented in a 20-page booklet that describes its properties, uses, storage, and handling. The distributor advises that, on request, they will make recommendations for safe disposal. Copies are available from the Organic Chemicals Dept., Dow Chemical U.S.A., 9008 Bldg., Midland, Mich. 48640. [Circle 428]

Private screening. Product Bulletin 3236, a two-page data sheet describing the Accucoat model 3236—a wide-area screen printer for surface-mounting technology—is available free. It includes three photos, specifications, and a general description. Ask for it from Aremco Products Inc. at (914) 762-0685, or drop a note to 23 Snowden Ave., Ossining, N.Y. 10562. [Circle 429]

Pride of the force. A new electronic recruit to police work, the model LPD-2000 argon-laser print detector for forensic applications, locates latent fingerprints previously inaccessible. A data sheet is free from Trimedyne Laser Systems Inc., 701 S. Kirkman Rd., Orlando, Fla. 32811; phone (305) 298-1561. [Circle 433]

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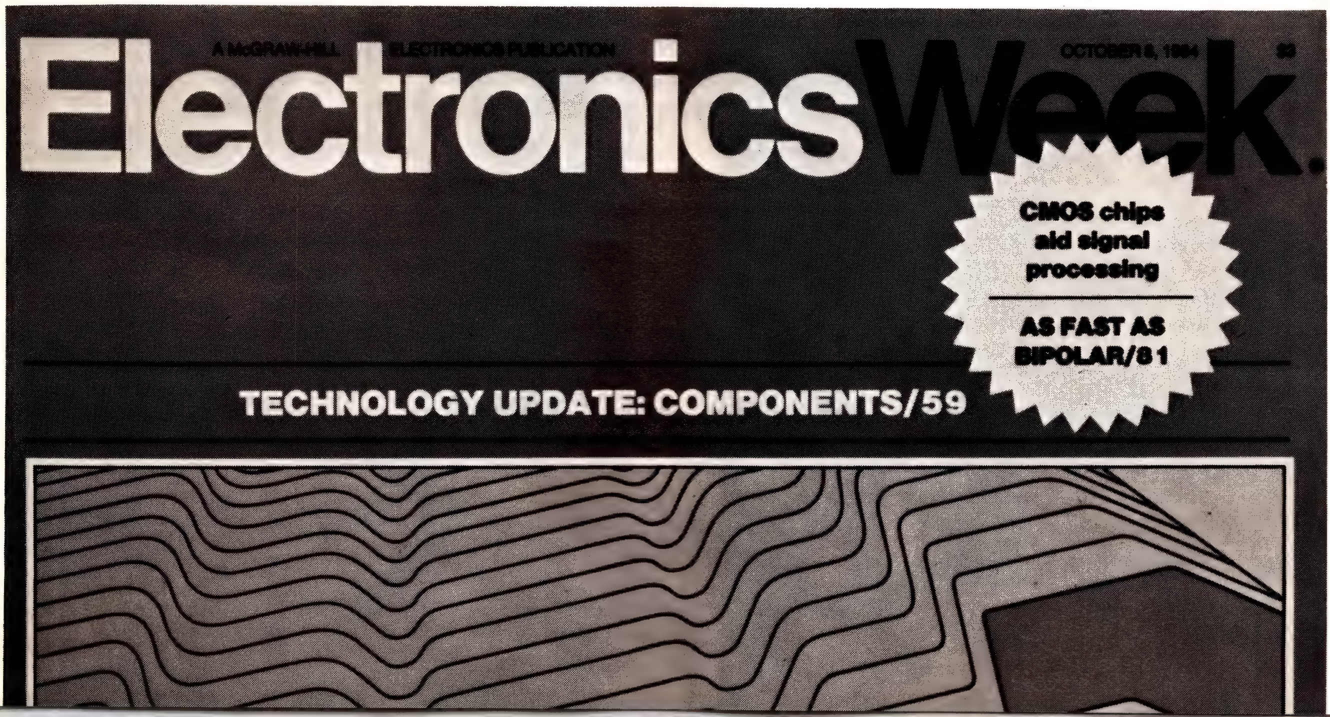
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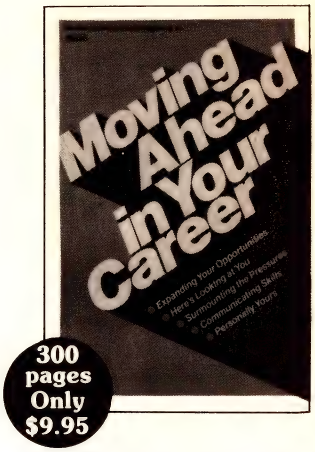
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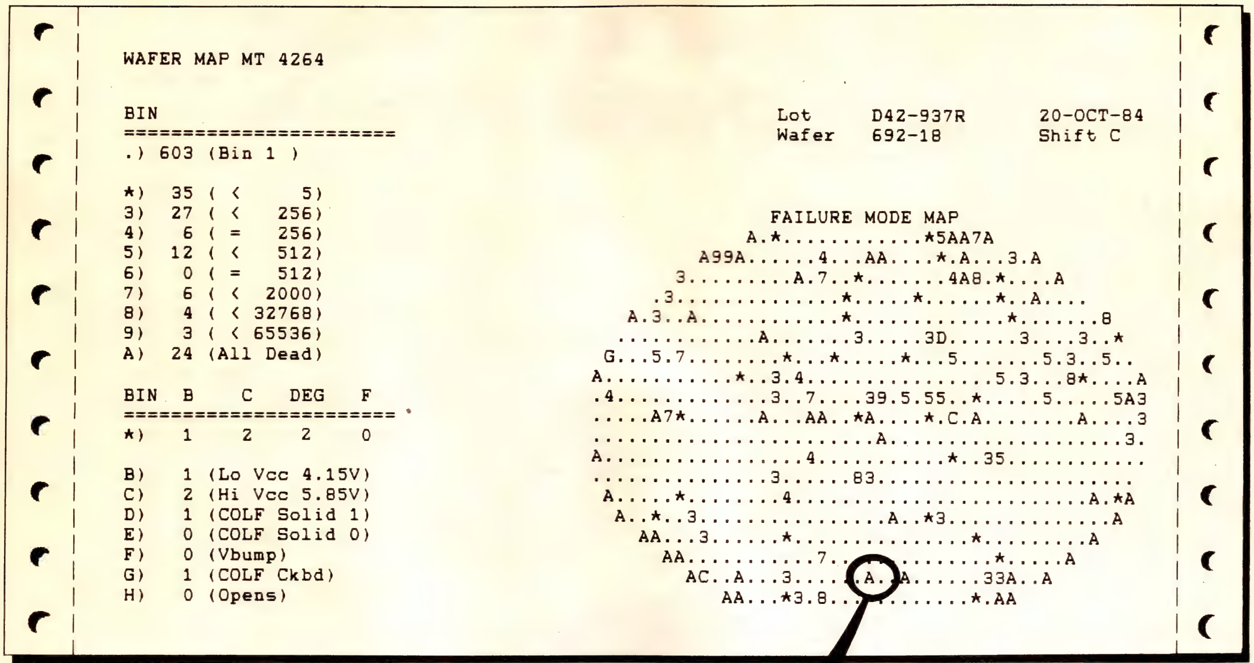

```
WAFER MAP MT 4264

BIN
========================
.) 603 (Bin 1 )

*)  35 ( <      5)
3)  27 ( <    256)
4)   6 ( =    256)
5)  12 ( <    512)
6)   0 ( =    512)
7)   6 ( <   2000)
8)   4 ( <  32768)
9)   3 ( <  65536)
A)  24 (All Dead)

BIN  B    C   DEG   F
========================
*)   1    2    2    0

B)   1 (Lo Vcc 4.15V)
C)   2 (Hi Vcc 5.85V)
D)   1 (COLF Solid 1)
E)   0 (COLF Solid 0)
F)   0 (Vbump)
G)   1 (COLF Ckbd)
H)   0 (Opens)
```

```
          Lot      D42-937R        20-OCT-84
          Wafer    692-18          Shift C


               FAILURE MODE MAP
             A.*............*5AA7A
         A99A......4...AA....*.A...3.A
       3.........A.7..*.......4A8.*....A
     .3..............*.....*......*..A....
   A.3..A............*.............*.......8
  ............A.......3.....3D......3....3..*
 G...5.7........*...*.....*...5.......5.3..5..
A...........*..3.4................5.3...8*....A
.4.............3..7....39.5.55..*.....5.....5A3
.....A7*......A...AA..*A....*.C.A........A....3
........................A....................3.
A.................4...........*..35............
...............3......83......................
 A.....*........4.........................A.*A
  A..*..3................A..*3..............A
    AA...3......*...............*.........A
      AA...........7..............*.....A
        AC..A...3......A..A......33A..A
           AA...*3.8............*.AA
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Advertising Sales Staff

Atlanta, Ga. 30319: Don Seay
4170 Ashford-Dunwoody Road N.E.
[404] 252-0626
Boston, Mass. 02116:
Joanna Henderson
575 Boylston St.
[617] 262-1160
Chicago, Ill. 60611
Betsy A. Otto [312] 751-3739
William J. Higgens III [312] 751-3738
645 North Michigan Avenue
Cleveland, Ohio 44113: Joe Milroy
[215] 496-3800
Costa Mesa, Calif. 92626: Debbie Smith
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Dallas, Texas 75240: Harry B. Doyle, Jr.
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[214] 458-2400
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3333 Wilshire Blvd.
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1221 Avenue of the Americas
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[313] 352-9760
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Larry Goldstein, Lauren Scott, Lynne Simonfy
425 Battery Street
[415] 362-4600

Brussels: Art Scheffer
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Tokyo: Akio Saijo
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1985 WILL BE GOOD— IF...PERHAPS...MAYBE...

All the curves will continue to head upward in 1985, says our Annual Market Report (p. 61), even though the rate of ascent will be somewhat flatter than it was during the initial stages of the recovery early last year. On the other hand, there is some thought that the growth projections—most notably that worldwide production of electronic equipment will increase 17% a year until 1988—might be too conservative. The reason, says one analyst, is that prospects have brightened over the past few months. On still another hand (economists are permitted—indeed, need—at least three hands, not to mention heads), the poor performance of the semiconductor industry in the last quarter of the year just ended casts a shadow over the whole exercise.

At the same time, and also on the down side of the ledger, projected capital spending for next year will fall almost 2%, according to figures from the "31st Annual McGraw-Hill Fall Survey of Preliminary Plans for New Plants and Equipment, 1984-86." Not only that, but with the Reagan Administration's economic policy still subject to conjecture, trial by leak, and the slings and arrows of David Stockman's Office of Management and Budget, it is difficult to make plans for spending or predict the economy's health beyond the day after tomorrow. (If all the conflicting advice about what to do is not enough to make one tremble, consider also that Treasury Secretary Donald Regan admits that his department never estimated the effects on the economy of its tax-reform proposal, perhaps the most far-reaching such change in history.)

What's becoming evident is that the Administration is thrashing about seeking a place to go. Because everyone else seems willing to provide free directions, here are ours.

We begin, as any economist would, by assuming that certain truths are self-evident. For one thing, if the whopping deficit is not reduced, either by new tax regulations or increased taxes (in some cases, the same thing), or by slashes in spending, the whole boom is liable to go crash—and then all the fine plans and expectations won't be worth the paper they're printed on. For another, the interest rate must come down, or else financing for expansion will be pushed out of the reach of business; at the same time, innovation and expansion would be stifled by a shortage of capital. Thus, to make those optimistic predictions come true, the deficit must be cut—by reducing outlay, including that for defense—and interest rates must be reduced.

So what kind of year will 1985 be for the electronics community? Well, it will be good, but not that good; or it will be better than the last half of 1984; or it will be flat with a slump in the last quarter. The point is that the indicators look good, but so much depends on the inclination of President Reagan that it is difficult not to be at least a little bit worried. Much was written before the election campaign that a second-term Reagan, without another election to be concerned about, could show his true colors and strive to secure his place in history. Fair enough; the voters have decided that they are comfortable with that prospect, even so far as to know and like what those colors will turn out to be. But while he takes soundings and watches the infighting of his advisers, the economy is approaching a fork in the road. It's time for a strong signal from the White House about priorities in deficit reduction, spending cuts, tax reform, and the like.

Earlier, we mentioned "economic policy." Has anyone out there seen one?

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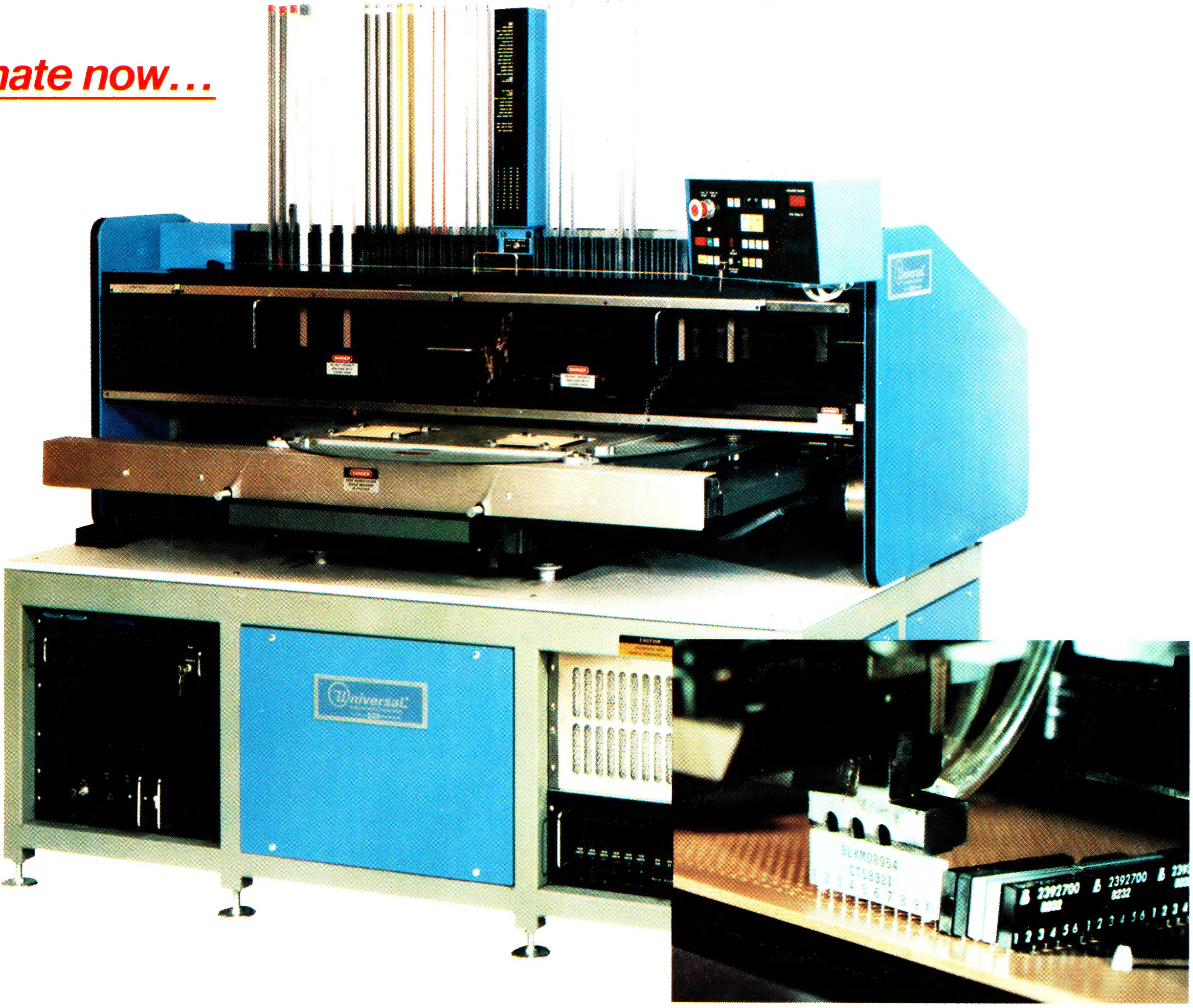

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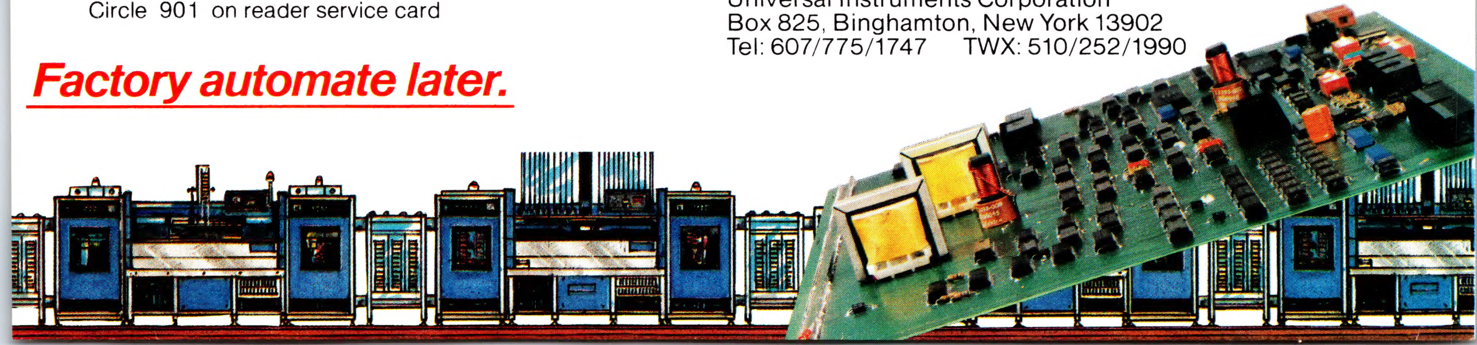

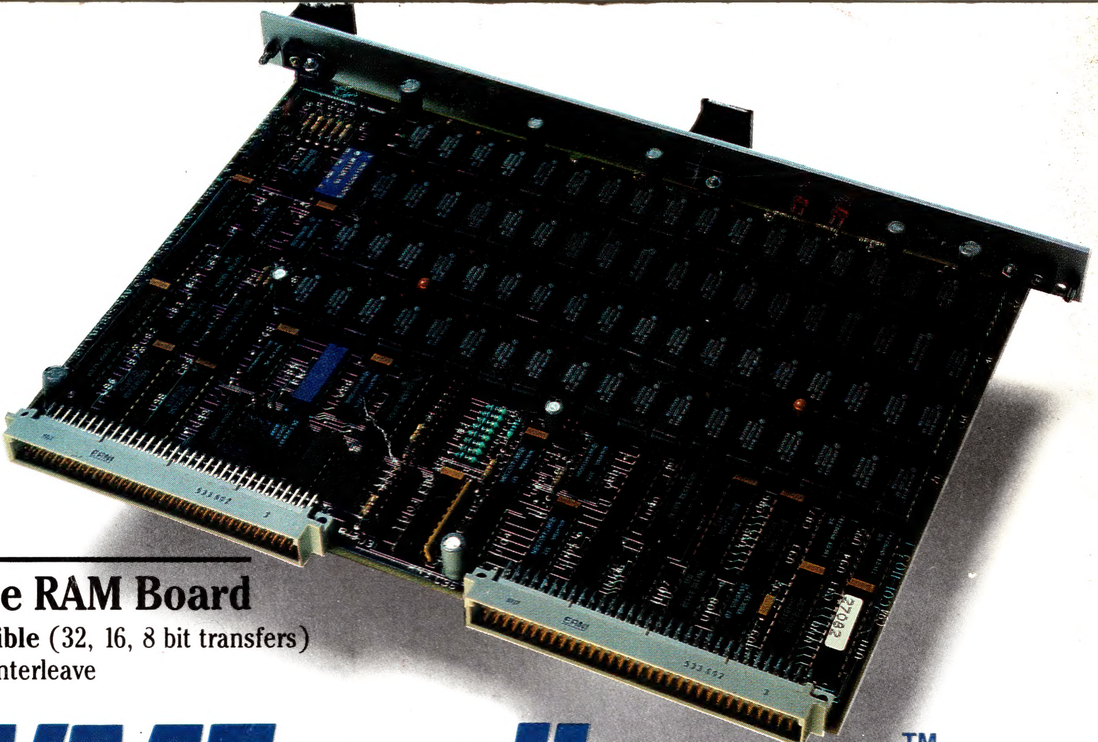

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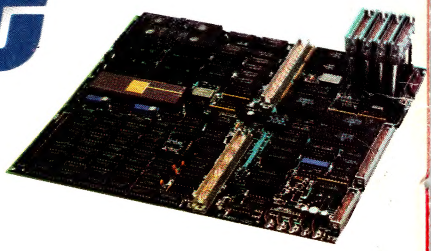

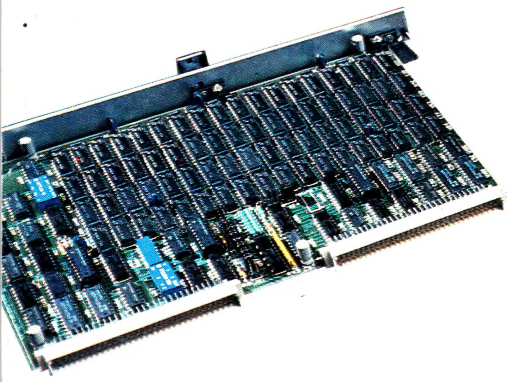

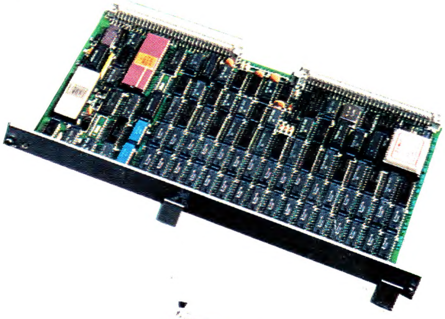

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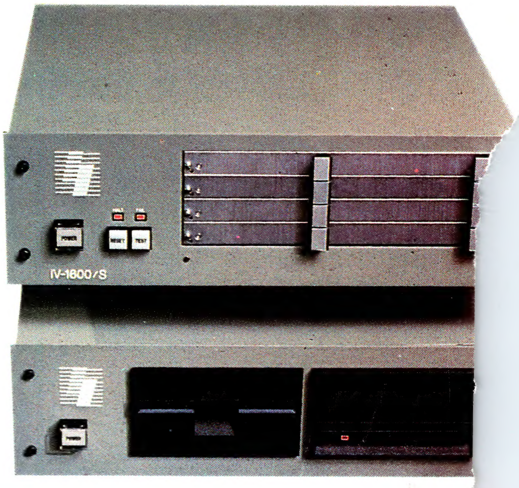

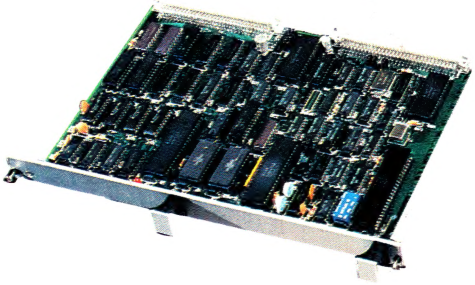

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Computer Systems Division
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